DRAFT:CMB:djm:2/2/73
Rewritten:DRAFT:CMB:djm:2/5/73

REMOTE SENSING AND ENVIRONMENTAL PARAMETERS IMPORTANT IN THE LIFE CYCLE OF THE SCREWWORM FLY

SUMMARY

The proposed test site program is a 2-year experimental effort to determine the feasibility of NASA and NOAA satellites to define the environment of the screwworm fly in Mexico. Earth Resources sensors will be used in an attempt to define broad geographic regions where =

	Temperature Long-term	Temperature Short-term	Experimental Sensors
(1) Adult flies-overwinter	53° F	-----	ESMR, VTPR, VHRR of NOAA satellites
are inactive	60° F	60° F	
die	49° F	20° F	
(2) Pupae-die	$\pm 47^{o}$ F	$\pm 13^{o}$ F	

INTRODUCTION

The fly is the adult form of the screwworm. However, this insect goes through metamorphosis in its development passing sequentially through the egg, larvae, and pupae stages prior to emerging as an adult. Each life form has its own environmental requirements for sustaining itself and proceeding normally through development. It might be summarized that environmental monitoring is important only in the adult and pupae

stages since the egg and larval stages are not measurably influenced by the external environment.

Listed below are critical temperature requirements summarized for various life stages as reported by investigators over the past 38 years:

EGG = Optimal temperature-that of the host animal (surface 98^{0}-102^{0} F)

Death - Occurs below 59^{0} F

LARVAE = Optimal temperature-that of internal animal (temp 98^{0}-105^{0} F)

Immobilized - At 40^{0} F soil temperature, development severely slowed

Death - Occurs at 15^{0}-20^{0} F even for short periods ($<$ 1 day) or 32^{0} F for longer periods $>$ 2 weeks

PUPAE = Death - Occurs at 13^{0}-23^{0} F soil temperature for short periods ($<$ 1 day)

Death - Occurs below 47^{0} F/air temperature (above dry soil) for long periods

Rare Survival - Occurred at soil temperatures less than 55^{0} F for longer periods

ADULT = Death - Occurs below 20° F/air temperature for short periods of time

Death - Occurs in large percent with sudden changes in temperature

Death - Occurred when mean air temperature was 49° F for 3 months; 53° F for 5 months

Immobilized - Below 60° F/air temperature

Does Not Lay Eggs - Below 63° F

Overwintering - Occurred as low as 53.3° F lowest mean temperature

Population Declines - When monthly mean air temperature is less than 60° F

DISCUSSION

To evaluate critical temperatures in the life cycle, one must consider the arena in which the insect is active. For example eggs are laid only on edges of wounds of warm blooded animals. The temperature experienced by the egg is directly a result of the radiant energy emmitted by the host animal and is little influenced by outside sources such as ambient air, wind, rain, etc.

The larva spends the major portion of its life inside a wound on the animal. However, toward the end, it drops to the ground where, for a short interval of time, it is influenced by ambient air and energy of the radiating soil surface, which may reach temperatures of 130-140° F in the summer. It quickly wiggles its way into the upper 3-17 inches of soil, depending on the type of soil.

The pupae are surrounded by the soil, and the length of time spent in this stage depends on the soil temperature and its moisture content. For example, emergence to the adult occurs after 10 days at 75° F or is delayed to 30 days at 60° F soil temperature. Increased humidity causes an extended pupation time (Example: emergence after 60 days at soil temperature of 60° F with 100% humidity). As a whole, the influence of soil moisture is not well understood.

The adult occupies the first few feet of airspace near the earth's surface. Its well-being is influenced primarily by air temperature and humidity at that level. Adults are generally inactive at night. They normally seek the brightest sunshine areas except under conditions of high ambient temperature. They are less active on cloudy days and become completely inactive with heavy cloud cover. Activity is retarded by winds of 5-6 mph and is prevented by velocities of 15 mph. They are inactive during continuously rainy periods. Nocturnal resting places are along streams on 4-5 feet high leafless twigs. Flies do not inhabit

heavy, dense forests. They are found more commonly in bushy areas rather than on open plains. They have never been found resting on buildings, caves, burrows, or in any deep shade. However, they may visit shady areas to lay their eggs.

A five-month period with 0.4 inches average rainfall per month is the lower limit of moisture required for overwintering. The maximum tolerance is 5 inches per month. Largest populations occur in areas having rainfall of 1.5 to 3 inches per month.

SENSORS

The Very High Resolution Radiometer (VHRR) of NOAA-2 will yield effective blackbody radiation temperatures. These temperatures will be related to actual ground temperatures in the varied zones of the test site. It appears likely that it will be possible to discriminate temperatures precisely enough to map areas favorable to screwworms. Effective day-and-night blackbody radiation temperatures will be noted as well as the daily cycle of temperatures, vegetation and soil zones, emissivities of these zones, rainfall, and similarities of adjacent areas. Ground truth will be direct soil temperature measurements and ground-level air temperature measurements. In addition to instrumental calibrations (e.g., space readings), test calibrations with sea temperatures and that of a large lake within the test site will be performed.

By empirical correlations, also verified by ground truth, the relation between air temperatures and soil temperatures will be observed. These have been widely studied for agricultural purposes.

The Vertical Temperature Profile Radiometer (VTPR) of NOAA-2 provides a more direct measurement of lower air temperature. Although the surface temperature is the least reliable portion of the temperature profile, it is worth examining for this study.

The Electronically Scanning Microwave Radiometer (ESMR), a new instrument of NIMBUS-5, may have some application. It promises to measure soil moisture constant, and can help interpret temperature variations.

Data from all available sources will be used to backup observations from weather satellites. This will include ERTS data from a contiguous test site, aircraft overflight data, ground observations from the Health Applications Office team and those of the Mexican Meteorological Service.

Primary Technical Contacts - The Health Applications Office staff has contacted the following concerning technical feasibility of determining ground and air temperatures of importance in analysis of the screwworm environment and data processing procedures.

Dr. Russell Koffler and Dr. Paul McClain
Environmental Sciences Group
National Environmental Satellite Service
National Oceanic and Atmospheric Administration
Washington DC 20031 - Tel (202) 899-1278
763-2745

Dr. Gerald Barger, Director and Dr. Richard Felch
Agricultural Climatology Service and Environmental Data Service
National Oceanic and Atmospheric Administration
Silver Spring, MD 20910 - Tel (202) 447-7919
343-5262

Mr. John D. Overton
Code TF-4
Chief, Data Requirements Branch
Earth Observations Division
Manned Spacecraft Center
Houston, TX 77058 - Tel (713) 483-6479

REFERENCES

1. Weather Influences, Dr. Gerald Barger W. S. USDA Unpublished talk, no date.

2. Biology of the Primary Screwworm Fly, Cochliomyia Americana, and a Comparison of Its Stages with Those of C. Macellaria, by E. W. Laake, E. C. Cushing, H. E. Parish, USDA Tech. Bulletin #500, Jan. 1936.

3. Effect of Weather on Cochliomyia Americana and a Review of Methods and Economic Applications of the Study, by D. C. Parman, Journal of Econ. Entomology, Nov. 1945.

4. Susceptibility of Screwworm Larvae and Prepupae to Desiccation, by A. H. Baumhover, Journal of Econ. Entomology, Aug. 1963.

5. Relative Importance and Seasonal Activity of Cochliomyia Americana C.S.P. by E. F. Knipling and B. V. Travis, Journal of Econ. Entomology, Oct. 1937.

6. Nocturnal Resting Places of the Screwworm Fly, by B. G. Hightower Journal of Econ. Entomology, Aug. 1963.

7. Reproductive Behavior of Laboratory-reared Screwworm Flies, by M. M. Crystal, Journal of Med. Entomology, Nov. 1967.

8. Effects of Acidity, Alkalinity and Moisture Content of the Soil on Emergency of Cochliomyia Americana C.S.P. by Roy Melvin, B. C. Bushland, Journal of Econ. Entomology, Oct. 1938.

5 YEAR

SCHEDULE RESPONSIBILITY _____

STATUS RESPONSIBILITY _____

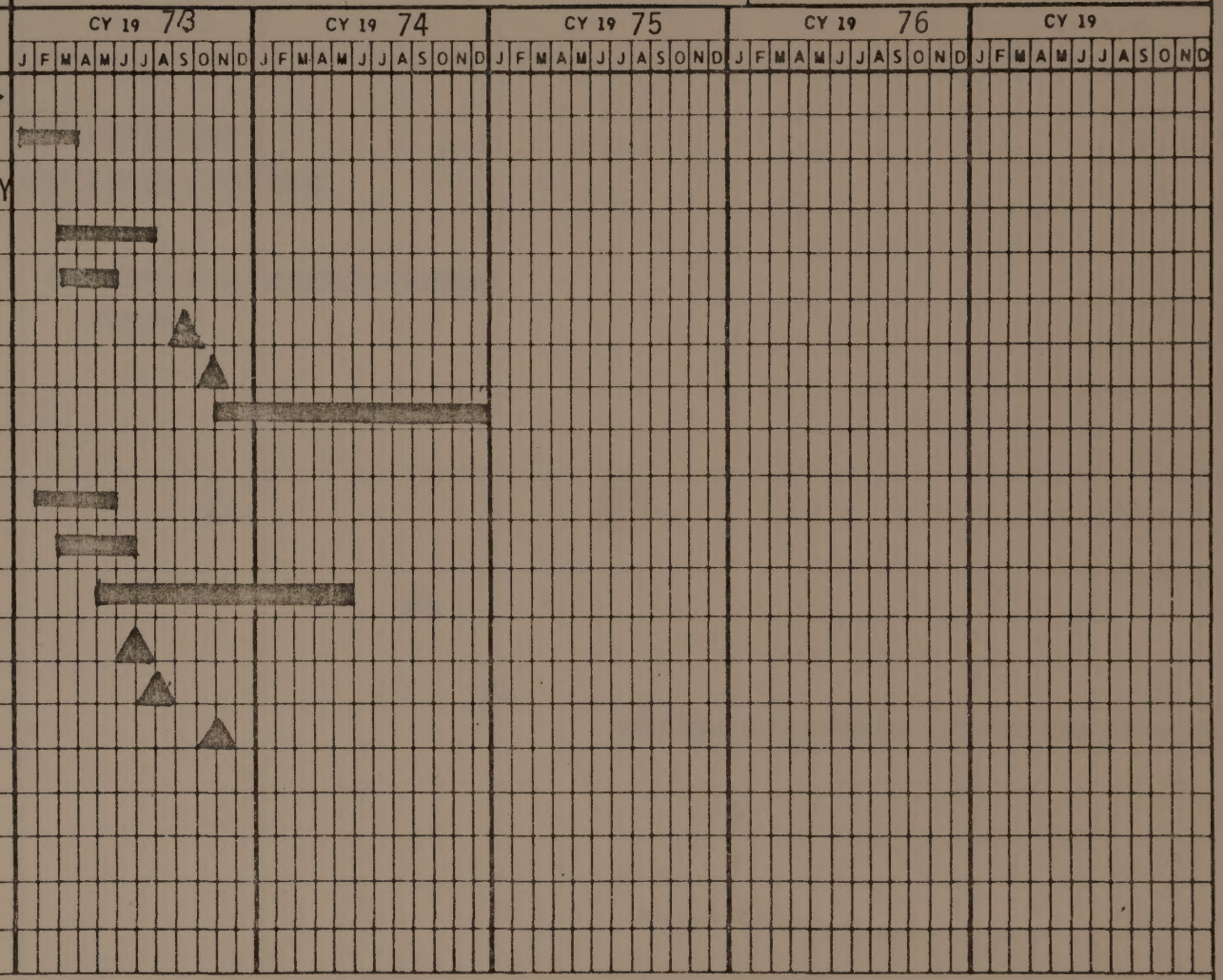
SCREWWORM PROGRAM

ORIGINAL SCHEDULE APPROVAL _____ (DATE)

LAST SCHEDULE CHANGE _____ (DATE) (NO.) (INITIALS)

STATUS AS OF 15 03 73 (DATE) (INITIALS)

	MILESTONES
1	PLANNING
2	GENERAL PROGRAM PLAN
3	DETAILED STUDY + FEASIBILITY
4	PHASE PLAN
5	ESTABLISH MEX. LIAISON
6	DATA HANDLING PLAN
7	DETAILED PROGRAM PLAN
8	DEMONSTRATION PHASE
9	TEST SITE
10	TEST EQUIP. SPECS.
11	TEST EQUIP. PROCUREMENT
12	GROUND INVENTORY
13	TEST EQUIP. EMPLACEMENT
14	A/C INVENTORY OF TEST SITE
15	TEST SITE READY
16	
17	
18	
19	
20	



NOTES

MSC Form 965E (Aug 68)

5 YEAR

SCHEDULE RESPONSIBILITY _____

STATUS RESPONSIBILITY _____

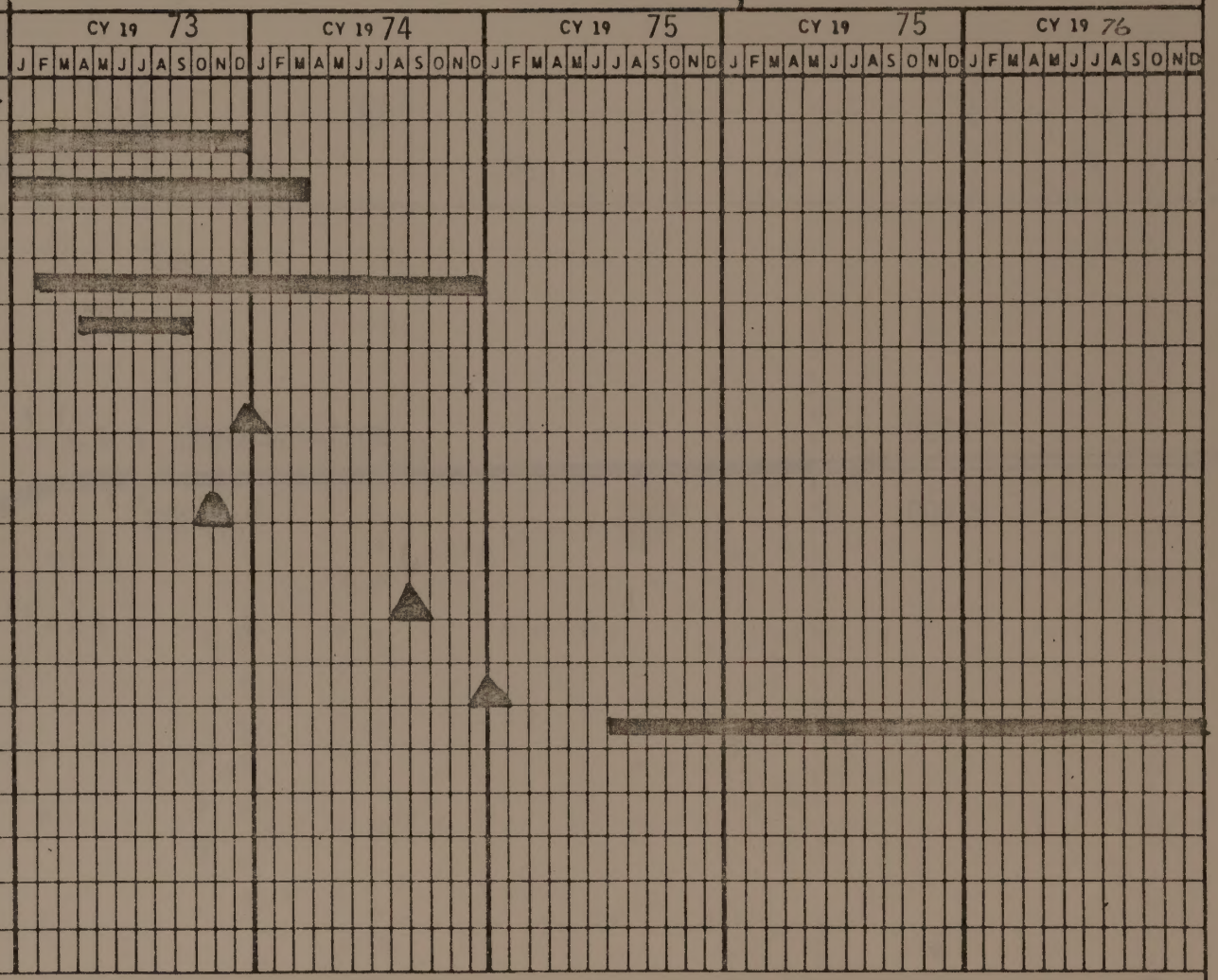
SCREWWORM PROGRAM

ORIGINAL SCHEDULE APPROVAL _____ (DATE)

LAST SCHEDULE CHANGE _____ (DATE) (NO.) (INITIALS)

STATUS AS OF 15 03 73 (DATE) CF (INITIALS)

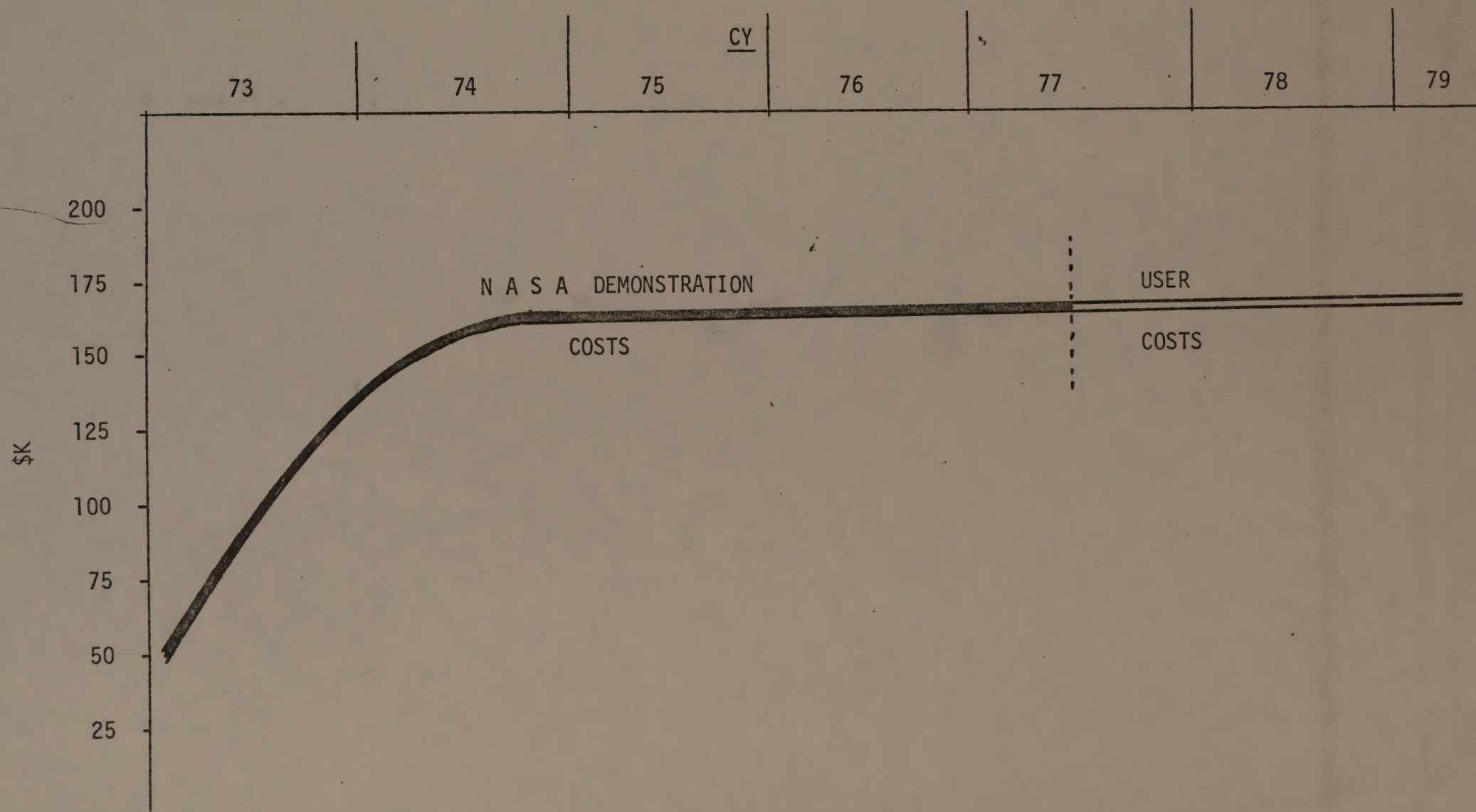
	MILESTONES
1	DATA ACQUISITION
2	OBTAIN NIMBUS DATA
3	ERTS, S/L DATA
4	ANALYSES
5	NIMBUS DATA FAMILIARIZATION
6	DEVELOP ERTS DATA HANDLING
7	TEST AND EVAL. DATA
8	HANDLING PROCEDURES
9	DAY/NIGHT CORRELATION
10	NIMBUS DATA
11	ERTS SEASONAL MAP OF
12	MEX. HYDRO FEATURES
13	DEV. OPERATIONAL PROCEDURES
14	FOR OA PHASE
15	OPERATIONAL DEMONSTRATION
16	
17	
18	
19	
20	



NOTES

MSC Form 965E (Aug 68)

ANNUAL COSTS - SCREWWORM REMOTE SENSING PROGRAM



EARTH RESOURCES SURVEYS

in support of the

LIFE SCIENCES

a proposed program

for the

LYNDON B. JOHNSON SPACE CENTER

TWO KINDS OF RESEARCH PROPOSED

- A DEDICATED IN-HOUSE EFFORT
  - CLOSELY ALLIED WITH EOD
  - CS/CONTRACTOR STAFF MIX
- A UNIVERSITY APPLIED RESEARCH PROGRAM

PROPOSED IN-HOUSE RESEARCH (LIFE SCIENCES)

(1) MAJOR DEMONSTRATION OF REMOTE SENSING APPLICATION

- ASSIST IN INTERNATIONAL SCREWWORM ERADICATION PROGRAM

ELEMENTS=

- DATA PROCESSING NIMBUS/ITOS DATA TO USEFUL FORMAT
- GROUND TRUTH MEASUREMENTS
- TEMPERATURE MAPPING
- SOIL MOISTURE SURVEY
- SURVEY HYDROLOGIC FEATURES

(2) STUDIES OF DISEASE VECTOR ENVIRONMENT

ELEMENTS=

- MOSQUITOES AND OTHER INSECTS
- SNAILS

PROPOSED IN-HOUSE RESEARCH (LIFE SCIENCES) .- Concluded

(3) STUDIES OF LIFE QUALITY FACTORS

ELEMENTS=

- POLLUTION
  - AIR
  - WATER
- LIVING CONDITIONS
  - URBAN HEALTH, PLANNING
  - RECREATION AND PARKS
  - ENVIRONMENTAL FACTORS
  - DISASTER SURVEY

PROPOSED UNIVERSITY PROGRAM AS APPLIED TO PUBLIC HEALTH

(1) COOPERATIVE EFFORT WITH USER AGENCIES

ELEMENTS=

- HOUSTON GALVESTON AREA COUNCIL - URBAN HEALTH
- STATE HEALTH DEPARTMENT
  - AIR QUALITY BOARD
  - SHELLFISH CONTAMINATION

(2) CONSULTANT SERVICES IN PUBLIC HEALTH

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND TECHNOLOGY RESUME

1. DATE PREPARED	2. PRIOR NUMBER/CODE	3. CURRENT NUMBER/CODE
March 16, 1973	0	160-75-34

4. TITLE - Major Application Demonstration - Using Nimbux/ITOS Data in Screwworm Eradication

5. PERFORMING ORGANIZATION	8. CONTRACT/GRANT NO.	
TBD	TBD	
	9. STARTING DATE: July 1973	10. ANNIVERSARY DATE: July

6. INVESTIGATOR'S NAME	TELEPHONE NO.	11. FUNDING (In K)		12. STATUS
TBD		PRIOR FY 72-73	20	C
		CURRENT FY 74	160	C
7. NASA TECHNICAL MONITOR'S NAME	TELEPHONE NO.	BUDGET FY 75	160	C
C. M. Barnes, D.V.M., Ph. D.	(713)483-5406	13. INSTITUTION CATEGORY: IN		

14. SUPPORT REQUIRED	15. ACTIVITY PERCENT				
	THEORY	INSTRUMENT DEV	DATA REDUCTION	GROUND RESEARCH	SUPPORT
A	5	0	50	30	15

16. DESCRIPTION

Background and Description: Screwworms, a costly parasite of warm blooded animals, have been eradicated from the U.S. However, overwintering populations in Mexico invade the U.S. periodically. (Cost to Texas ranchers in 1972 - $100 million).

The Department of Agriculture of Mexico and the U.S. have agreed to eradicate this fly to the narrow isthmus of Mexico using the sterile fly technique. This procedure calls for mass laboratory rearing of the flies and sterilizing them with Cobalt-60 radiation and releasing overwhelming numbers of sterile flies among the native population. As a result, no young are produced and insects gradually disappear.

The number of reporting weather stations in Mexico is limited and to drop expensive sterile flies without knowledge of local environmental conditions can be costly. Additional weather stations can be built to measure climate of the varied terrain of Mexico. However, it will be more cost beneficial to use the newer Nimbus and NOAA operational weather satellites to discriminate areas where the screwworm can survive. Daily coverage giving such information is proposed for delivery to eradication control officials planning aircraft flights for dispersal of sterile insects. Such remote sensing data can indicate where and when flies should be dropped and perhaps predict the effectiveness of drops in any area.

If this technology is successful in aiding screwworm eradication, the same procedures might logically be used in eradicating other pupating insects of importance to man, viz., the tsetse fly.

NASA Participation: (1973-74) NASA will develop a test site in Mexico to prove that NIMBUS/ITOS data can adequately define the screwworm environment. Elements required are ground temperature, soil moisture, vegetative cover, water sources. If successful, during the operational phase (1975-78) NASA will provide routinely a detailed plan suggesting where screwworm flies are likely to be found and a flight plan suggesting where drops of sterile flies might be most effective. This information will be derived from analysis of NIMBUS, ITOS, ERTS and other satellite data tapes and will be a major demonstration of the usefulness of remote sensing.

FOR HEADQUARTERS USE ONLY

17. INSTITUTION CODE	18. SIGNATURE AUTHORITY	19. WORK SUPPORT	20. DISCIPLINE

NASA FORM T8 JAN 72 REPLACES NASA FORM T3 WHICH IS OBSOLETE.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND TECHNOLOGY RESUME

1. DATE PREPARED	2. PRIOR NUMBER/CODE	3. CURRENT NUMBER/CODE
March 16, 1973	160-75-28/29	

4. TITLE
Life Sciences Applications of Remote Sensing

5. PERFORMING ORGANIZATION	8. CONTRACT/GRANT NO.	
TBD	TBD	
	9. STARTING DATE: July 1973	10. ANNIVERSARY DATE:

6. INVESTIGATOR'S NAME	TELEPHONE NO.	11. FUNDING (In K)		12. STATUS
TBD		PRIOR FY		
		CURRENT FY 74	200	nc
7. NASA TECHNICAL MONITOR'S NAME	TELEPHONE NO.	BUDGET FY 75	200	c
C. M. Barnes, D.V.M., Ph. D.	(713)483-5406	13. INSTITUTION CATEGORY		

14. SUPPORT REQUIRED	15. ACTIVITY PERCENT				
	THEORY	INSTRUMENT DEV	DATA REDUCTION	GROUND RESEARCH	SUPPORT
AO	10	0	10	75	5

16. DESCRIPTION

This research is a continuation of an exploratory effort to determine the feasibility of using remote sensing in public health, ecology, and environmental survey of importance to the life sciences.

Included in planned activities are demonstrations with support from several user agencies in defining the unique habitat supporting the life cycle of the fly, mosquitoes and other insects, and snails. All of these are carriers or intermediate hosts for important human and/or animal diseases.

It is planned to also conduct remote sensing studies in several life quality factors: pollution of air and water, urban planning, and disaster analysis.

The research to be conducted will be a mixed civil service and contractor staff effort utilizing existing facilities and technology.

FOR HEADQUARTERS USE ONLY

17. INSTITUTION CODE	18. SIGNATURE AUTHORITY	19. WORK SUPPORT	20. DISCIPLINE

NASA FORM T8 JAN 72 REPLACES NASA FORM T3 WHICH IS OBSOLETE.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND TECHNOLOGY RESUME

1. DATE PREPARED	2. PRIOR NUMBER/CODE	3. CURRENT NUMBER/CODE
March 16, 1973	160-75-28/29	

4. TITLE

Remote Sensing in Applied Public Health Problems

5. PERFORMING ORGANIZATION

University of Texas School of Public Health
P.O. Box 20186 - Astrodome Station
Houston, TX 77025

8. CONTRACT/GRANT NO.

TBD

9. STARTING DATE: July 1973

10. ANNIVERSARY DATE: July

6. INVESTIGATOR'S NAME: Ruell Stallones, M.D.

TELEPHONE NO.: (713)741-0400

7. NASA TECHNICAL MONITOR'S NAME: C. M. Barnes, D.V.M., Ph. D.

TELEPHONE NO.: (713)483-5406

11. FUNDING (In K)			12. STATUS
PRIOR FY		67	C
CURRENT FY	74	50	C
BUDGET FY	75	120	C

13. INSTITUTION CATEGORY: UM

14. SUPPORT REQUIRED	15. ACTIVITY PERCENT				
	THEORY	INSTRUMENT DEV	DATA REDUCTION	GROUND RESEARCH	SUPPORT
AO	20	0	20	50	10

16. DESCRIPTION

This research will consolidate specific public health problems in shellfish contamination, respiratory air pollutants, urban health, and disease vectors into one contractual effort. The contractor will operate at a low level of effort in conjunction with specific health department agencies to solve current problems of public health. Emphasis will be given to exploring new and unusual concepts of disease study, control, and/or eradication from the view of cost effective use of remote sensing technique. He will develop such expertise that the University may be considered a Center of Excellence in the public health use of remote sensing. He will supply a ready staff of consultants as needed to meet NASA requirements in epidemiology, medical entomology, bioenvironmental engineering, and urban public health.

FOR HEADQUARTERS USE ONLY

17. INSTITUTION CODE	18. SIGNATURE AUTHORITY	19. WORK SUPPORT	20. DISCIPLINE

NASA FORM T8 JAN 72 REPLACES NASA FORM T3 WHICH IS OBSOLETE.

REMOTE SENSING AS AN AID TO SCREWWORM ERADICATION

- SCREWWORMS ARE A VILE, EXPENSIVE AGRICULTURAL PEST
- SCREWWORMS OVERWINTER MANY PLACES IN MEXICO, ESPECIALLY ON THE GULF COAST
- EVERY SUMMER THEY SPREAD INTO THE US THROUGH TEXAS AND OTHER BORDER STATES
- CONTROL IS BY USDA STERILE FLY DROPS ON THE BORDER, BUT INFESTATIONS RECUR EVERY SUMMER
- MEXICO AND US WILL ERADICATE SCREWWORMS IN OVERWINTERING AREAS EXTENDING TO TEHUANTEPEC, THE NARROWEST PART OF MEXICO

REMOTE SENSING CAN

- HELP IDENTIFY OVERWINTERING AREAS
- HELP INDICATE WHERE AND WHEN TO DROP STERILE FLIES
- SENSORS WILL BE SCANNING PRIMARILY RADIOMETERS ON METEOROLOGICAL SATELLITES, PARTICULARLY, VHRR OF NOAA AND PERHAPS NIMBUS SATELLITES
- COSTS OF THE PROGRAM ARE MODEST - COST BENEFIT RATIO IS FAVORABLE
- TWO-YEAR TEST PHASE TO DEVELOP CONCEPT
- THREE-YEAR OPERATIONAL PHASE

THE SCREWWORM FLY

- SCREWWORMS ARE PARASITES AFFECTING WARM-BLOODED ANIMALS
- HAVE BEEN ERADICATED FROM U. S. USING AERIAL DISTRIBUTION OF STERILE FLIES
- FLIES EXIST IN MEXICO AND ANNUALLY ENTER U. S. (LOSSES - $ 100 MILLION - '72)

SCREWWORM FLY ERADICATION IN MEXICO

- NEW JOINT AGREEMENT FOR ERADICATION
  ($ 40 MILLION - BEGINNING 1975)
- FLY'S ACTIVITY DEPENDENT ON PROPER ENVIRONMENT
- MEXICAN WEATHER STATIONS LIMITED
- TOPOGRAPHY OF MEXICO VARIED
- USDA HAS REQUESTED ASSISTANCE IN DEFINING ZONES
  SUPPORTING SCREWWORM GROWTH

NASA CONTRIBUTIONS TO SCREWWORM ERADICATION

- WILL ESTABLISH TEST SITE IN INFESTED ZONE*
- WILL UTILIZE REMOTE SENSORS TO ANALYZE AREAS PRODUCING SCREWWORMS
  - a) TEMPERATURE VARIANCE OVER LARGE AREAS
  - b) GROUND COVER
  - c) OTHER TERRAIN FEATURES - SOIL MOISTURE
- IF TEST RESULTS SUCCESSFUL, PROPOSE SATELLITE DATA BE USED IN MAJOR ERADICATION EFFORT TO
  - a) SHOW INFESTED AREAS
  - b) SUGGEST ZONES FOR STERILE FLY DROPS
  - c) PREDICT EFFECTIVENESS OF DROPS

* WITH MEXICAN NASA COOPERATION

Research: Remote Sensing, Screwworm

Mr. Taylor

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS 77058

REPLY TO ATTN OF: DD12/L-023/73

MAY 1 1973

Dr. M. E. Meadows
USDA - ARS
Animal Health Division
Screwworm Eradication Program
P.O. Box 969
Mission, TX 78572

Dear Dr. Meadows:

As you know NASA and the ARS are initiating a screwworm test site operation in Mexico within the near future. A major effort will be studies concerning local climatology within the test site. Such data will be compared to satellite coverage of the same area. This work will require climatology instrumentation and we have arranged for our contractor, the School of Public Health, University of Texas at Houston, to furnish this equipment. My understanding is that they in turn have contracted with Science Associates for this purpose.

Our contacts with Dr. Allen Heflin, USDA Mexico City, have resulted in their furnishing an import permit for this instrumentation. He has suggested that it accumulate in your warehouse until transportation will be available to Mexico City. My understanding is that the equipment will be shipped in 7 packages for a total weight of about 500 pounds. These packages will arrive separately at various times in the near future. Since the entry permit is for one package of 500 pounds, I suppose we will need a single crate in which we can put the 7 cartons.

Since ARS has agreed to furnish the test site with one USDA vehicle from your area, it is suggested that it be used to transport the equipment through the border and direct to the test site.

I trust these arrangements will not seriously inconvenience your staff. If there is a problem, please let me know.

Sincerely,

Charles M. Barnes

Charles M. Barnes, D.V.M., Ph. D.
Manager, Health Applications Office
Health Services Division

RECEIVED
MAY 11 1973
AREA OFFICE
WESLACO, TEXAS

cc:
See Attached

cc:
Dr. Allen Heflin
Mexico City Ag SEA
Department of State
Washington, DC 20521

Dr. R. C. Bushland
USDA-ARS
P.O. Box 969
Screwworm Research Station
Mission, TX 78572

Mr. E. A. Taylor
USDA
P.O. Box 267
Weslaco, TX 78596

Mr. Conning
Science Associates, Inc.
230 Nassau Street
P.O. Box 230
Princeton, NJ 08540

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
SOUTHERN REGION
Subtropical Texas Area
Citrus Insects Inv., 509 West Fourth St.
Weslaco, Texas 78596

May 17, 1973

Subject: Remote Sensing Meeting in Mexico with Dr. Barnes.

To: E. A. Taylor, Area Director

A telephone call was received from Dr. Barnes on May 16, 1973 concerning a meeting with Mexican NASA people and other interested groups regarding remote sensing for applications in the screwworm program. He would like to have the USDA participate.

Dr. Barnes was trying to set up a tentative agenda such as the following:

1. May 21. Meet at Embassy in Mexico City to coordinate the program with the Science Attache. (Will contact him on Monday morning).

2. May 22. Technical discussion with Mexican Space Commission and others. He would like to have the following represented: Someone from USDA, Mexican Space Comm., Conacit (?), and hopefully INYA. He is not sure where this meeting would be. He proposes the following agenda for this session:

   a. Villasenor - Status and plans.
   b. Barnes - Remote sensing possibilities.
   c. Comments from attendees.
   d. Giddings - Details of data processing.
   e. Barnes - To discuss a proposed organization
   f. Ask Mexicans to respond to proposals.

   - Lunch -

   Afternoon Session

   g. Questions and answers on specific points.
   h. Mid-afternoon - Draw up a rough basic agreement.
      State general consensus of attendees.
      Get feelings of group in order to move ahead with program.
      After initialing agreement American and Mexican staff would go to test site to define limits, etc. (Items such as furnishing building by Mexico would be discussed.) They would like USDA representative to go with them.

The people to be in test area full time would be proposed.
Jerry Barger, Meteorologist from NASA staff, would go to area for 60-90 days (at least) to place equipment.
The staff will be based in Houston.
Note: They are looking for an entomologist.

Dr. Barnes had talked with Hightower earlier in the week and he would like to go. However, he has not received his passport and will not do so in time. Barnes would like to have you call him as soon as possible and indicate who will represent USDA.

Bill

William G. Hart
Research Leader

EAT

14 June, 1973

SUBJECT: Report on remote sensing conference

TO: R.C. Bushland

A summary of the meeting with INIA, NASA, CONEE, and SA officials to begin remote sensing of weather data in Mexico is attached. Our phase of the project can begin as soon as Ing. Velasco can hire technicians and acquire the necessary vehicles.

B.G. Hightower

B.G. Hightower

June 14, 1973

To - E A Taylor

Dr. Hightower's report is forwarded with two xerox copies. Another copy is retained in the mission file.

R C Bushland

Application of Remote Sensing Technology

To Screwworm Population Dynamics Studies

A meeting of representatives from ARS, INIA, NASA, CONEE, and Sanidad Animal was held in Mexico City on 5-6 June, 1973, to consider the agreements needed to insure coordinated efforts in a proposed application of remote sensing to the predicition of outbreaks of screwworms. The validity of the concept of the project was accepted by all participants. However, there was considerable discussion about the kinds of agreements needed by the individual agencies. The agreements between ARS, INIA, and NASA appeared to be adequate. Presumably, INIA and Sanidad Animal have had their respective roles in this project defined by SAG.

The Mexican space agency (CONEE) pointed out that their participation depended upon a request for assistance from a Mexican organization. Since CONEE cannot initiate such a request, NASA will present the proposal to the Joint Mexican-American Screwworm Eradication Commission. Approval by this commission will entail a subsequent reqest directly to CONEE or through the Secretaria de Agricultura y Ganaderia. The reaction of Sanidad Animal to the proposed work plan will probably be a critical factor in the disposition of the request.

Following the meeting in Mexico City, ARS, INIA, NASA, and CONEE personnel met in Cordoba, Veracruz to survey the proposed test site. Central Veracruz was selected as the test site for the following reasons:

1. All-weather roads offering easy access to 4 distinct climatic

Application of Remote Sensing Technology

To Screwworm Population Dynamics Studies

A meeting of representatives from ARS, IAEA, NASA, COMEX, and Sandad Animal was held in Mexico City on 5-6 June, 1973, to consider the agreements needed to insure coordinated efforts in a proposed application of remote sensing to the prediction of outbreaks of screwworms. The validity of the concept of the project was accepted by all participants. However, there was considerable discussion about the kinds of agreements needed by the individual agencies. The agreements between ARS, IAEA, and NASA appeared to be adequate. Presumably, IAEA and Sandad Animal have had their respective roles in this project defined by SAG.

The Mexican space agency (COMEX) pointed out that their participation depended upon a request for assistance from a Mexican organization. Since COMEX cannot initiate such a request, NASA will present the proposal to the Joint Mexican-American Screwworm Eradication Commission. Approval by this commission will entail a subsequent request directly to COMEX or through the Secretaria de Agricultura y Ganaderia. The reaction of Sandad Animal to the proposed work plan will probably be a critical factor in the disposition of the request.

Following the meeting in Mexico City, ARS, IAEA, NASA, and COMEX personnel met in Cordoba, Veracruz to survey the proposed test site. Central Veracruz was selected as the test site for the following reasons:

1. All-weather roads offering easy access to 4 distinct climatic

zones typical of southeastern Mexico.

2. Presence of native screwworm populations (not influenced by releases of sterile flies) in one or more of the above climatic zones throughout the year.

3. Access to meteorological facilities at Veracruz and in the Papaloapan River Basin complex.

4. Proximity of the test site to Mexico City for NASA-CONEE coordination of data processing and for scheduling of mapping and remote sensing missions by CONEE aircraft.

5. Proximity to INIA technical and administrative support facilities at Campo Cotaxtla. Screwworm survey teams will be trained and initially based at Campo Cotaxtla.

Proposed Schedule of Project Activities

1. Ing. H. Velasco, INIA, will supervise the establishment of screwworm case-incidence surveys and trap lines in the 4 climatic zones shown on the attached map. It is anticipated that 4-6 traps will be operated in each zone. ARS will assist and advise in the screwworm population sampling techniques, i.e. placement of traps and collection of data from cooperating ranchers. This phase of the project will probably begin on or about 15 July, 1973. One technician may later be based in Cordova to work areas C and D. All screwworm samples that may be collected in any test areas will be submitted to Screwworm Eradication headquarters in Mexico City for inclusion in their periodic survey reports.

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2. A NASA meteorologist will establish headquarters in Cordoba to supervise the collection and interpretation of meteorological data from 20 portable recording weather stations to be placed in the test areas. He will also coordinate the collection of data from existing Mexican weather stations in Central Veracruz. Probable starting date will be 31 July, 1973. The recording weather stations have been ordered and delivery is expected within the next few weeks.

3. A detailed NASA proposal including estimated costs for CONEE participation is being prepared for presentation to the next meeting of the Joint Mexican-American Screwworm Commission. The scheduling of acquiring, processing, and correlating remote sensing data will depend on the outcome of this presentation.

B. G. Highland

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VERACRUZ
PICO DE ORIZABA
CORDOBA
ORIZABA
RIO BLANCO
ALEMAN
Boca del Monte Rotetos
Punta Mocambo
Soledad de Doblado
Villa Tejeda
Paso del Macho
Arroyo Naranjo
Cotaxtla
Mata Pinacho
Tamarindo
La Finaja
Río Blanco
Cosalapa
Acatlán
Tierra Blanca
Tehuacán
Orizaba
Cuichapa
Amatlán
Yanga
Cuitlahuac
Ixhuatlancillo
Tlaxcoyan
Piedras Negras
Estanzuela
Tetetla
Tezonapa
Omealca
Presidio
Zongolica
Mixtla de Altamirano
Teocelo
Coxquihui
Teziutlán
Nicolás Bravo
Azumbilla
Cuesta Blanca
Esperanza
Huatusco
Coyolillo
Estanzuela
Estanzuela
Estanzuela

14 June, 1973

SUBJECT: Report on remote sensing conference

TO: R.C. Bushland

A summary of the meeting with INIA, NASA, CONEE, and SA officials to begin remote sensing of weather data in Mexico is attached. Our phase of the project can begin as soon as Ing. Velasco can hire technicians and acquire the necessary vehicles.

B.G. Hightower

B.G. Hightower

June 14, 1973

To - E A Taylor.

Dr. Hightower's report is forwarded with two Xerox copies. Another copy is retained in the mission file.

R C Bushland

Application of Remote Sensing Technology

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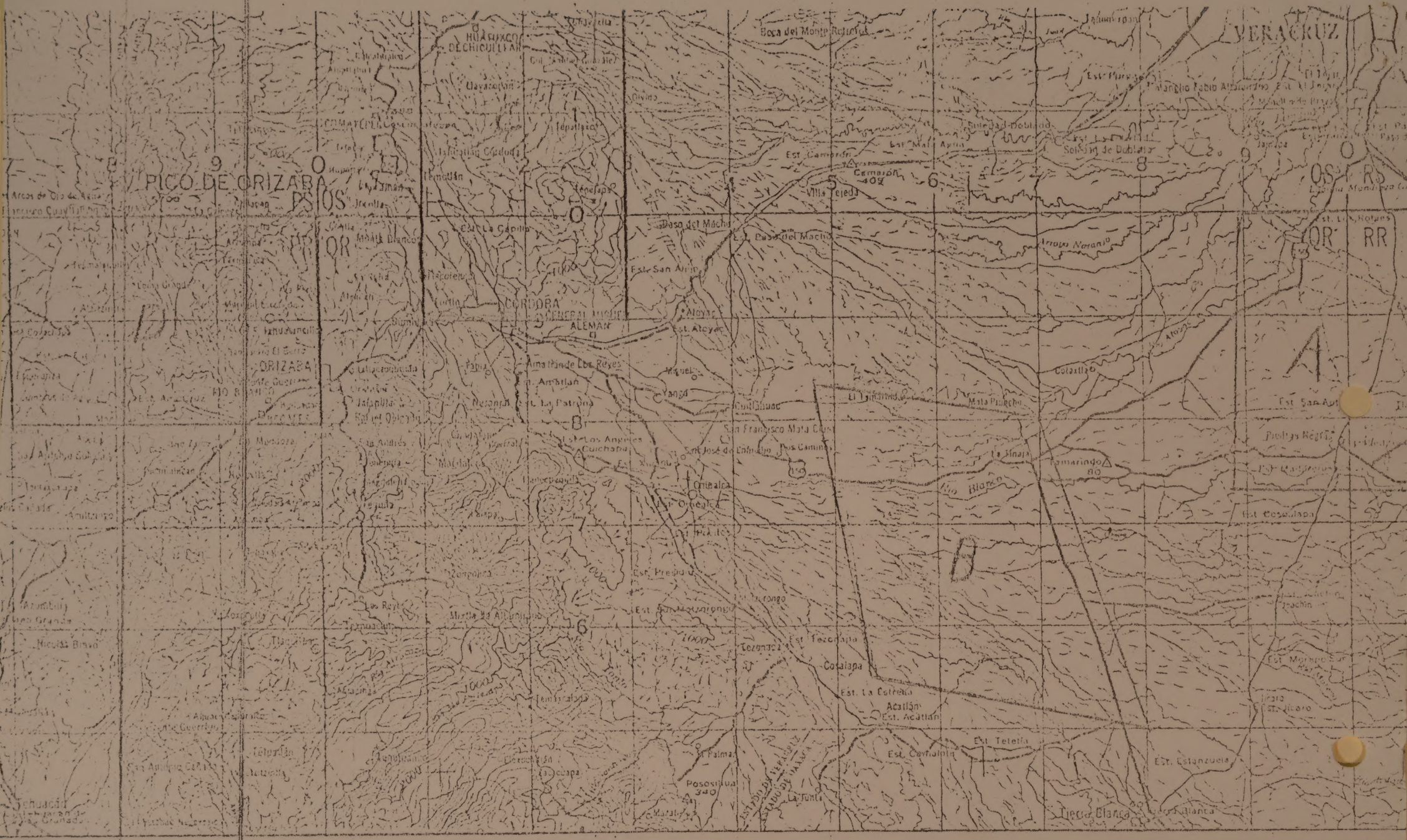
B. B. Highsmith


VERACRUZ
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Villa Tejeda
Cerro Blanco
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Cuichapa
Omealca
Palma
Posoistua
Yanga
Cotaxtla
Mata Pilacho
Arroyo Naranjo
Río Blanco
Estanzuela
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some signal of southwestern Indian.

d. Presence of native southwestern population (not indicated by presence of shovels fixed) in one or more of the Ohio Climatic zones throughout the year.

e. Access to meteorological facilities of Tennessee and to the Tennessee River Basin complex.

f. Proximity of the test site to Walker City for data-digital correlation of data processing and for scheduling of aerial and radio sounding stations by Ohio aircraft.

g. Proximity to IGY Terminal and scientificative support facilities at Camp Crowder. Reservoir survey teams will be trained and initially based at Camp Crowder.

Proposed Schedule of Project Activities

1. Jan. 8, Nelson, IGY, will survey the establishment of reservoir case-localions survey and trig lines in the 4 climatic zones known as the attached map. It is anticipated that two teams will be operated in each zone. One will remain and work in the reservoir population sampling techniques.

1-4. Placement of items and activation of data from reservoirs. This phase of the project will probably begin on or about 15 Sept. 1957. The technician may limit to have to do-done by mid-June 1 and 2. All reservoirs indicate that they activated in the first quarter will be functional by December. Preliminary investigations to begin July for evaluation to begin after data obtain.

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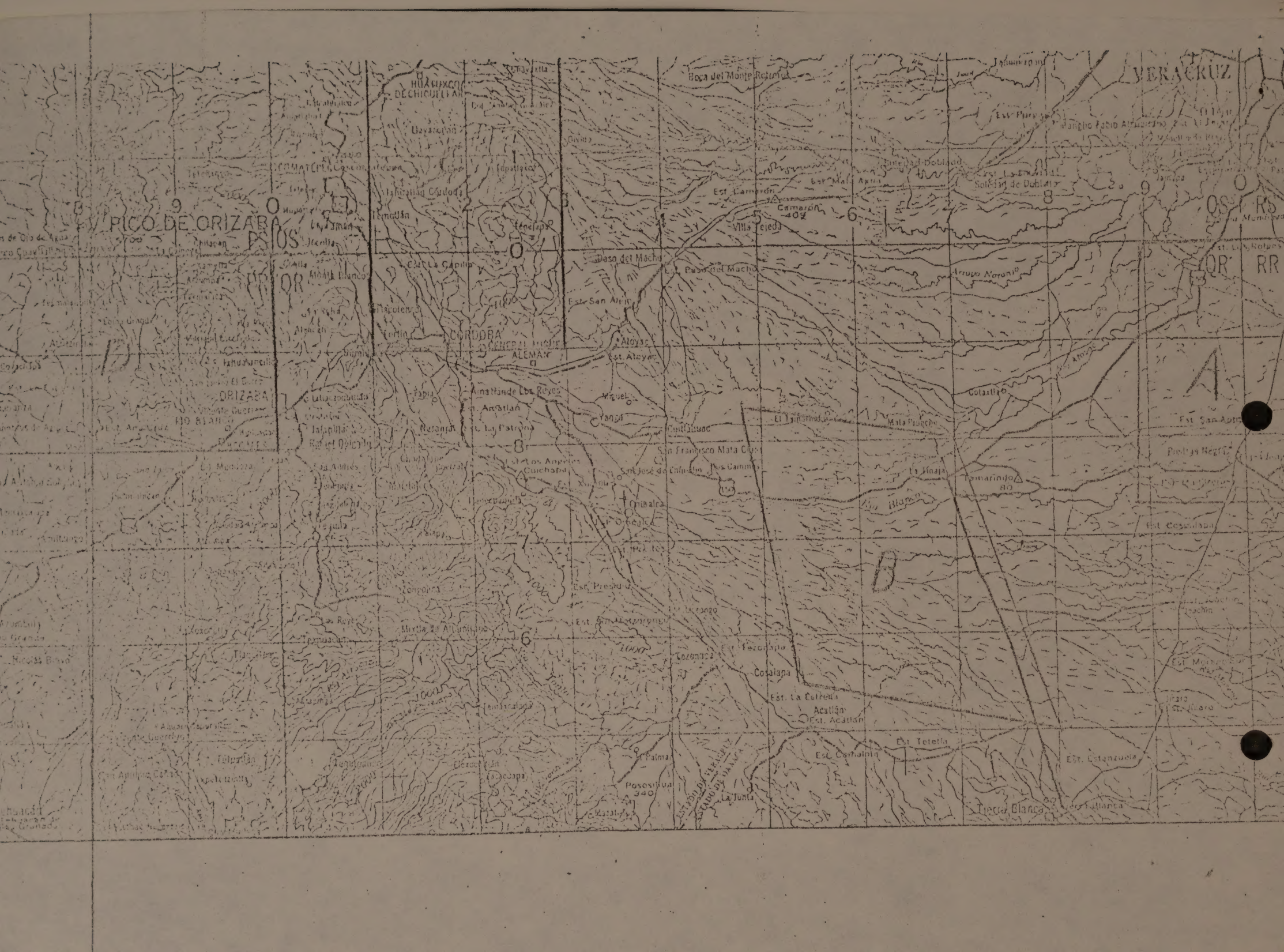
B. G. Highfill


VERACRUZ
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Cotaxtla
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UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
NATIONAL PROGRAM STAFF
Plant and Entomological Sciences
Beltsville, Maryland 20705

Eof

June 19, 1973

Subject: Department of State Telegram

To: E. A. Taylor, Area Director
Weslaco, Texas

A copy has just come to my desk of an unclassified telegram from McBride, American Embassy in Mexico, to the Secretary of State, Mexico 3919, June 1. The subject is possible cooperative remote sensing screwworm eradication experiment. It refers to a conference that NASA has requested with Mexican officials. A proposed date is set for June 5 at "CONACYT" headquarters. The representatives of the government of Mexico are proposed to be Dr. Enrique Martin del Campbell, Director, Center for International Cooperation; other potential attendants would be from the Agriculture Department Screwworm Commission, CONEE, Department of Defense, and possibly FONSEC. NASA representatives might be Dr. Barnes, the head and deputy head of the ERTS program, and headquarters representative Andrews. Also mentioned are Heflin, R. Smith, and Simon Pietri.

It is indicated that Mexico desires a broad discussion of possibilities including all technical aspects, but without commitment at this stage. It is also requested that NASA be prepared to discuss specific assistance such as equipment, personnel, data processing, and supplementary overflights.

The meeting has already occurred if held as proposed and you may have been tuned in on the whole matter but I thought I should pass this information along to you in the event you had not heard of it.

L. S. Henderson

L. S. Henderson
Staff Scientist

cc:
Dr. Bushland

RECEIVED
JUN 22 1973
AREA OFFICE
WESLACO, TEXAS

File

Bushland for review + comments

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

JUN 29 1973

REPLY TO
ATTN OF: I

Comision Mexico-Americana
Para La Erradicacion
Del Gusano Barrenador
Tres Picos #79
Mexico, D.F. Mexico

Gentlemen:

At the request of the Mexican Consejo Nacional de Ciencia y Technologia (CONACYT), we are forwarding a suggestion for a cooperative Mexico/U.S. experiment to determine if remote sensing technology can assist in the location and hence eradication of the screwworm fly. This proposal was discussed at meetings convened by CONACYT in Mexico City on June 5-6, 1973, and attended by CONACYT, the Comision Nacional de Espacio Exterior (CONEE), the Mexican Secretaría de Agricultura and Ganadería (SAG), and Dr. Villaseñor of the Joint Commission as well as the National Aeronautics and Space Administration (NASA), the U.S. Department of Agriculture (USDA), and U.S. Embassy personnel.

It is proposed that the experiment be conducted as a joint effort between NASA and the USDA on the U.S. side and CONEE and the SAG (possibly including both the Sanidad Animal and the Instituto Nacional de Investigaciones Agricolas (INIA) divisions). It is proposed that this project begin as soon as possible and last for approximately 18 months. The timing is important because, if the remote sensing experiment is successful, this technique may offer the Joint Commission both a cost- and time-savings approach in its screwworm eradication effort in northern and central Mexico, which is scheduled to begin in January 1975. If successful, this experiment could serve as a model for applying remote sensing to the detection and eradication of other pupating insects, which could, in turn, have far reaching implications in the health applications field.

The objective of this project would be to determine if the climatological factors most conducive to the growth of the screwworm insect (such as soil moisture, temperature, and vegetative cover) can be detected by remote sensors, thereby defining more accurately the affected zone for aerial seeding of sterile screwworm flies.

To carry out this experiment, it is proposed that a test site be selected in southern Mexico (south of the current boundary of screwworm control operations to preclude the effects of sterile fly release on the naturally occurring population) and that data be acquired by meteorological and remote sensing spacecraft and possibly by the Mexican CONEE remote sensing aircraft, with accompanying ground truth to confirm the predicted results of the remotely acquired data. Data analysis headquarters for the experimental effort could, at least initially, be established at the NASA Johnson Space Center in Houston, Texas.

It is proposed that each side use its best efforts to carry out the following general responsibilities:

The U.S. would acquire and process data from its meteorological and remote sensing satellites, as appropriate; provide on loan for the test site meteorological equipment to acquire local temperature and moisture measurements; provide test site personnel support and vehicles as required to assist in the collection of ground truth data; provide use of computers and data analysis facilities at JSC, Houston, Texas, including office and laboratory space for Mexican specialists who may be co-located there; and supply U.S. project personnel at JSC to conduct data analysis.

Mexico would conduct, if possible, one overflight of the test site with the CONEE Aerocommander 500-B remote sensing aircraft (as well as up to three additional overflights if mutually agreed to be required); and provide minimal test site facilities, test site personnel, and Mexican participation in the data analysis.

If the proposed experiment is of mutual interest, we would expect that the experiment would be conducted on a cooperative basis, such that each side would be responsible for funding its responsibilities in the project. The experiment

could be agreed by an agency-to-agency exchange of letters involving NASA and CONEE and/or the USDA and the SAG. In order to carry out the remote sensing aspects of the project, NASA would hope that CONEE would be actively involved as the Mexican agency with technical expertise in this field. In addition, there is an ongoing cooperative remote sensing agreement between NASA and CONEE which could incorporate cooperative experiments such as these.

The attached proposal more fully describes the remote sensing experiment. We look forward to receiving the Mexican views as soon as possible on the proposed effort. If the proposal is of interest, please outline the subsequent actions required on the Mexican side to initiate the cooperative project.

Sincerely,

Carl R. Thomson

for Arnold W. Frutkin
Assistant Administrator
for International Affairs

Enclosure

A PROPOSAL TO TEST THE FEASIBILITY OF USING REMOTE SENSING TO ASSIST IN THE LOCATION OF THE SCREWWORM FLY

BACKGROUND

Use of Remote Sensing

a. General

During the past few years a program has been underway to develop earth survey techniques utilizing remote sensing from aircraft and from spacecraft. Resources which have been studied in this manner include definition of geologically important areas, coastal and estuarine areas, soils and soil moisture, crops, timber, land use, watersheds, sea state, transportation network, etc.

b. What is Remote Sensing?

Remote sensing may be thought of as the gathering of information without actual contact with the object or area being investigated. The earth observations instrumentation which gather such information take advantage of the physical principle that all materials radiate or reflect electromagnetic energy and the radiant spectrum is unique for each material making it identifiable. Spectral regions which have received primary attention for earth resources work include the visible, infrared, and microwave. Advanced photographic techniques are emphasized in the visible range; radiometers, spectrometers, and multispectral scanners in the ultraviolet, infrared; passive radiometers, scatterometers and side-looking imaging radars in the microwave region. Data accumulated from these sources indeed give the scientific investigator "new eyes" in observing man's environment. While these new methods are in their infancy when used in application to earth's problems, they are proving cost beneficial in several instances.

c. Remote Sensing in Application to Insects

During recent months effort has gone into a new program of the use of remote sensing to define environmental conditions which contribute to the degradation of human and animal

health. A major subject of study has been that of insects and arthropods important to man's well being. This has included one project to study the ecology of the screwworm fly as a model for all pupating insects. From this preliminary survey it is believed that remote sensing may assist in detecting the environmental conditions where this insect thrives. However, it is also evident that insufficient scientific information is avialable concerning the total environmental requirements for this particular insect. While some data is available in the literature such as optimum soil temperature desired by the pupal stage, a comprehensive ecological model must be further developed. The latter is part of an ongoing USDA/Mexican INIA research effort on the screwworm fly.

Climatology and the Screwworm Fly

The proposal to eradicate the screwworm fly from Northern Mexico is an ambitious project. However, in the United States, it has been shown that vast areas can be liberated from this insect pest. In the US eradication campaigns considerable gain was acquired by taking advantage of weather and climatological conditions which limited and defined more precisely the affected zone. For example, in the first Florida campaign an unusually severe winter killed numerous insects and suggested that the program be initiated some months previous to planned sterile insect releases. In Mexico, weather conditions should be considerably different. In the relatively flat southern US, the temperatures increase in the spring latitudinally from south to north. In Mexico, conditions should be affected considerably more by changes in altitude than by change of seasons. The terrain varies from the tropical lowlands to a central plateau and extends to numerous high mountain peaks. Several major canyons and river valleys complicate the climatology as their waters flow from the central highlands to the coast.

Another factor which influences the insect life cycle concerns the predominance of rainy and dry seasons in much of Mexico. The eradication campaign planners will undoubltedly take advantage of these seasonal ground moisture conditions which may preclude or enhance the development of insect pupae.

The problem is how does one determine appropriate climatological conditions precisely and in time to be of value to the eradication campaign. When working in the United States, planners received data from numerous weather stations operated by the US Weather Service. In addition, there were reports

of soil mosture and other factors relating to crop production routinely reported to USDA. Within Mexico, there are relatively few active weather stations and climatological data reported from other sources is minimal. Another major problem concerns the lack of communication systems between the reporting weather stations.

It seems logical to assume that additional detailed climatological data throughout Mexico is not only desirable but necessary to improve the cost effectiveness of the eradication program. Since it appears unlikely that sufficient detailed field reports will be available for planning purposes it will be necessary to increase the number of observation points and improve the communications network, or to use some other method of gaining climatologic information. Remote sensing technology from spacecraft might be able to provide this data in a convenient and timely format for operational use.

PROPOSAL

a. Test Site

An experiment is proposed to determine if remote sensing technology can be utilized to determine local climatology in a test site within Mexico. The test site would have terrain with varied altitude and environmental conditions which are conducive to the growth and study of the screwworm fly. It should be situated south of the current screwworm barrier drop zone to preclude the effects of sterile fly release on the naturally occurring population. A test site area near Cordoba, Veracruz is proposed.

It is proposed that a Mexican remote sensing aircraft overfly the test site to acquire information on vegetative cover and detailed geography to assist in the detailed ground studies on the test insect. Data would also be acquired at appropriate time intervals from meteorological satellites to compare with the entomological and/or climatological ground truth data. These data will consist of ground temperature measurements as inferred by the Very High Resolution Radiometer (VHRR) system aboard the NOAA-2 spacecraft and general moisture conditions as may be inferred by several spacecraft meteorological sensors. Final analysis of test site results will determine the feasibility of the use of remote sensing technology in the major screwworm eradication campaign.

It is proposed that the test site also be the subject of investigation by means of Earth Resources Technology Satellite (ERTS-1), provided it is still operational. It is anticipated that ERTS data will provide terrain and vegetation information useful in the overall evaluation. Some ERTS-1 imagery is currently available of the proposed test site area.

b. Remote Sensing Instrumentation

The basic question to be answered if remote sensors are to be used is what are the highly reliable parameters that can be observed which relate to the environment of the screwworm. From previous experience, the factors that strongly influence the screwworm fly propulation are soil moisture, temperature, and vegetative cover. Thes items may be influenced by latitude and, in Mexico, variations may be affected primarily by altitude.

The basic types of remote sensing instruments which might be used for measuring and recording temperature, and vegetative cover are summarized in the attachments.

c. Responsibilities

(1) It is proposed that NASA use its best efforts to acquire and process data from US meteorological and remote sensing satellites as appropriate; provide on loan for the test site 20 micro-meteorological stations to acquire local temperature and moisture measurements; provide test site personnel support and vehicles as requred to assist in the collection of ground truth data; provide use of computers and data analysis facilities at JSC, Houston, Texas (including the above--described support for any Mexican specialists who may be co-located at JSC); and supply project personnel at JSC to conduct data analysis.

(2) It is proposed that Mexico use its best efforts to conduct one overflight of the test site with the CONEE Aerocommander 500-B remote sensing aircraft (as well as up to 3 additional overflights if mutually agreed to be required); and provide minimal test site facilities, test

site personnel, and Mexican participation in the data analysis.

(3) The US Department of Agriculture (USDA) would provide, through an existing research contract with the Mexican Instituto National de Investigaciones Agricolas (INIA) for test site personnel, and for up to three vehicles, to asist in the collection of ground truth information.

d. Possible General working arrangements

(1) To carry out this project, it is suggested that CONEE and NASA serve as coordinating agencies and obtain the appropriate concurrences and participation of other Mexican and US Government agencies, as appropriate.

(2) It is suggested that CONEE and NASA each designate a Project Manager who will be responsible for coordinating the agreed functions and responsibilities of each research team with the other. It is proposed that a Joint Coordination Group be established as the principal instrument for assuring the execution of the project and for keeping both sides continuously infomed of project status at each stage. The remote sensing Coordination Group would keep the Joint Commission for Screwworm Eradication advised of the progress of the remote sensing experiment. The project teams at JSC and from Mexico as well as the test site teams would report to the Coordination Group.

(3) Data analysis headquarters for the experimental effort could, at least initially, be established at the NASA Johnson Space Center (JSC) in Houston, Texas. US Project management would be located in the JSC Health Applications Office (Health Services Division, Life Sciences Directorate). This office is co-located with the Earth Observations Division so that life science - related projects are conducted and supported by the Earth Observation staff, including aircraft data processing facilities. NASA would be willing to accommodat at JSC from one to four Mexican personnel to participate in the data analysis activities. (These personnel could include a Mexican project manager, data processors and analysts, scientists and/or photointerpreters.) While travel and subsistence would be borne by

the Mexican Government, NASA would provide office and laboratory space and secretarial and technical assistance, as required.

(4) For the test site, it is proposed that a Mexican test site director and a US co-director be designated to coordinate the day-to-day ground truth activities. The test site directors would report to the Project Managers and the Joint Coordination Group.

(5) This project would be conducted on a cooperative basis, such that each side would be responsible for funding its responsibilities in the project including travel and subsistence of its personnel and transportation charges on all equipment for which it is responsible.

(6) The results of the experiment would be reported to the Joint Commission on the Eradication of Screwworms for their determination on whether this technology would assist in the operational eradication efforts, scheduled to begin in January, 1975. The scientific results of the project would be reported to the international scientific community.

(7) The development of this project would be subject to the availability to each government of the necessary funds.

(8) This project could be agreed by an exchange of letters between the agencies involved, presumably NASA and CONEE (with the possible joint signatures of the USDA and SAG). The experiment could be incorporated under the ongoing cooperative remote sensing agreement between NASA and CONEE which was extended by an intergovernmental exchange of notes on June 15, 1972.

e. Timing of Experiment: It is proposed that the experiment begin as soon as possible and last for approximately 18 months. The timing is important because, if the remote sensing experiment is successful, this technique may offer both a cost-and time-savings approach to the Joint Commission in its screwworm eradication efforts.

ERTS INSTRUMENTATION OF VALUE IN SCREWWORM ENVIRONMENT RESEARCH

RETURN BEAM VIDICON (RBV)

NO. 1	.475 μ	to	.575 μ
NO. 2	.580 μ	to	.680 μ
NO. 3	.690 μ	to	.830 μ

MULTISPECTRAL SCANNER (MSS)

CHANNEL 1	.5 μ	to	.6 μ
CHANNEL 2	.6 μ	to	.7 μ
CHANNEL 3	.7 μ	to	.8 μ
CHANNEL 4	.8 u	to	1.1 μ

(INSTANTANEOUS FIELD OF VIEW 260 FT. X 260 FT.)

AIRCRAFT INSTRUMENTATION OF VALUE IN SCREWWORM RESEARCH

REMOTE SENSOR SYSTEM	MEASUREMENT/DISCIPLINE
PHOTOGRAPHIC	
COLOR PHOTOGRAPHY	BASE MAPPING
COLOR IR PHOTOGRAPHY	VEGETATION • SOIL MOISTURE • SOIL TYPE (POROSITY)
BLACK AND WHITE STERERO PHOTOGRAPHY	TOPOGRAPHY (FINE)
MULTI-SPECTRAL PHOTOGRAPHY	VEGETATION
INFRARED	
IR THERMAL SCANNER	TEMPERATURE GRADIENTS • SOIL MOISTURE • SOIL TYPE (POROSITY)
PRECISION RADIATION THERMOMETER	TEMPERATURE

MUCH INFORMATION IS INFERRED FROM THE DIRECT MEASUREMENT. FOR EXAMPLE, KNOWING THE TYPE VEGETATION PRESENT, THE SOIL TYPE IS KNOWN FROM THE REQUIREMENTS TO SUPPORT SUCH PLANTS, THE SOIL MOISTURE IS PARTIALLY INFERRED BY ASSESSING PLANT HEALTH OR STRESS.

U.S. DEPARTMENT OF AGRICULTURE

REFERENCE SLIP

DATE 7/10/73

TO R. C. Bushland

- [ ] ACTION
- [ ] NOTE AND RETURN
- [ ] APPROVAL
- [ ] PER PHONE CALL
- [ ] AS REQUESTED
- [ ] RECOMMENDATION
- [x] For Review & FOR COMMENT
- [ ] REPLY FOR SIGNATURE OF
- [ ] FOR INFORMATION
- [ ] RETURNED
- [ ] INITIALS
- [ ] SEE ME
- [ ] NOTE AND FILE
- [ ] YOUR SIGNATURE

REMARKS Please let us have your comments on the attached. You may keep the attached for your files as we have an extra copy.

E. A. Taylor

FROM E. A. Taylor

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL DATA SERVICE
Washington, D.C. 20235

Date : June 29, 1973

Reply to Attn. of:

RECEIVED
JUL 5 1973
AREA OFFICE
WESLACO, TEXAS

To : Dr. T.L. Noffsinger, W115

From : Gerald L. Barger, Director
Laboratory for Environmental Data Research

Subject: Continuing Cooperation with NASA and ARS, USDA in joint Mexico U.S. Screwworm Eradication Program

As you know, Dr. Felch and I have been working with ARS and APHIS for the past few years in documenting the impact of changing weather on the incidence and spread of the screwworm in livestock. With the transfer of the Agricultural Climatology Service Office functions and personnel from EDS to NWS I trust that you will be interested in continuing this cooperation in order to facilitate any eventual publication of "screwworm degree days" or perhaps a "screwworm moisture index" for the guidance of the sterile fly control program. One of the things I hope to foster while in Mexico during the next several months is a more prompt and reliable reporting of individual meteorological station data to some central point for prompt (weekly) transmission to Washington for summary and publication in the Weather and Crop Bulletin.

It was also anticipated in our cooperating with the States and agricultural agencies that Dr. Felch and I would be able to travel within the United States on NOAA funds, but that any participation in the program in Mexico would be at the expense of the cooperating agencies. I don't know yet what these requirements will be but will be looking forward eagerly to one or both of you being with us sometime during the year or more.

One of the NASA contributions to the cooperative weather effort is the purchase of some $6,000 worth of ground meteorological instruments. EDS has purchased a large number of inexpensive rain gauges as token contribution and actually as a very real advantage as we will be able to offer every rancher a rain gauge who may want it within the test site between Veracruz and Mexico City. These instruments will be distributed in a manner which will permit interpretation of the remotely sensed observations and we hope to establish casual relationships between weather and the screwworm fly during the approximately two-year period we have before the control program will be extended into the southern half of Mexico. For the first time we have an opportunity to obtain response data which are unbiased by the effect of the control program. That is, the screwworm activity will be influenced primarily by weather and animal wound availability rather than by the control program itself.

cc: Dr. Charles M. Barnes, NASA-DD12
✓Mr. E.A. Taylor, ARS, Weslaco, Texas

ID Document	1273
Form 1	Letter copy
Form 2	
Title	
# of Pages	2
Year	1973
Month	August
Day	31
Color?	☐
Spanish?	☐
Subject line	
Subject heading 1	remote sensing
Subject heading 2	NASA
Subject heading 3	Mexico
Subject heading 4	personnel
Description Note	attached September 14, 1973, Saulman to Charlesworth
Author Info	Charlesworth
Additional Authors	
Recipient	Mulhern
Sub-collection	Edward F. Knipling Papers
Treatment intent	scan & index
Temp CD folder	124
To be scanned?	☑ **Scanning completed?** ☐
To be re-keyed?	☐ **Re-keying completed** ☐
Out at SIG?	☐ **Group** GG
Chron Chapter	8 **Topical Chapter**

Scanned as EFK

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS 77058

Dr Williams
Please prepare answer

REPLY TO
ATTN OF: DD12

AUG 31 1973

Dr. Francis J. Mulhern
Animal and Plant Health
Inspection Service
U.S. Department of Agriculture
Room 316E, Administration Building
Washington, D.C. 20250

HOURRIGAN
SCHUBERT
KLINGSPORN
KNOWLES
MATHIS
SGEE

Dear Dr. Mulhern:

As you know, the Health Applications Office, L. B. Johnson Space Center, Houston, Texas is involved in a cooperative methods development project with agriculture's screwworm eradication group. The basic purpose is to determine the usefulness of remote sensing for defining the screwworm fly habitat in Mexico. A test site has been selected and it is expected that preliminary field work will begin in September 1973. We are already successfully processing satellite data with computers.

In accord with the remote sensing program plan, it was proposed that agriculture provide one or more representatives at the Johnson Space Center to work with our scientists in analysis of satellite data. This would include basic training in understanding sensors aboard the satellite, mapping environmental features including weather in Mexico, and preparing a consensus of where sterile flies should be released based on the above. It is hoped that these techniques can be developed and ready for use in the major eradication effort which we understand will begin in January 1975. Since this technology is new and unique, it is highly desirable, if not mandatory, that all personnel associated with the project begin their training as far in advance as possible. It is proposed that this phase of the work begin simultaneously with the Mexican field test effort in September.

Have staff members from your agency been designated for assignment to NASA in support of this activity? If so, we would like to begin integrating them into our work program as well as assist in any persoanl matters associated with a move to Houston. As in previous cases of agriculture employees detailed to this Center, we will be glad to furnish office space and routine clerical support for the persons selected.

RECEIVED
SEP 17 1973
AREA OFFICE
WESLACO, TEXAS

As you know, we are currently working with Drs. R. C. Bushland and William Hightower, Agricultural Research Service, USDA. They have arranged for several Mexican technical persons to assist in test site activities. With USDA staff members assigned to assist in data analysis and program management in Houston, a truly competent methods development team will undoubtedly result. If we are to be of maximum benefit to the Joint Screwworm Eradication Commission, we must begin field trials coupled with satellite observations as soon as possible.

Sincerely,

Clifford E. Charlesworth

Clifford E. Charlesworth
Manager, Earth Resources Program Office

ID Document	1272
Form 1	Letter copy
Form 2	
Title	
# of Pages	2
Year	1973
Month	September
Day	14
Color?	☐
Spanish?	☐
Subject line	
Subject heading 1	remote sensing
Subject heading 2	survey
Subject heading 3	NASA
Subject heading 4	Mexico
Description Note	attachment, August 31, 1973, Charlesworth to Mulhern
Author Info	Saulman
Additional Authors	
Recipient	Charlesworth
Sub-collection	Edward F. Knipling Papers
Treatment intent	scan grayscale & index
Temp CD folder	124
To be scanned?	☑ **Scanning completed?** ☐
To be re-keyed?	☐ **Re-keying completed** ☐
Out at SIG?	☐ **Group** GG
Chron Chapter	8 **Topical Chapter**

Scanned as EFK

copy to Bushland & Mr. E. A. Taylor

FILE: SECTION Research
SUBJECT Screwworm
FOLDER Remote Sensing

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WASHINGTON, D.C. 20250

14 SEP 1973

Your reference DD12

AIRMAIL

Mr. Clifford E. Charlesworth, Manager
Earth Resources Program Office
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas 77058

Dear Mr. Charlesworth:

This is in reply to your letter of August 31, 1973, concerning the possible use of remote sensing in connection with the screwworm program.

It is our view that remote sensing promises to be a valuable tool for future screwworm survey and evaluation. We feel, however, that at this time the work being done is primarily research oriented, rather than directed toward the regulatory activities of Veterinary Services. Dr. B. G. Hightower has been designated to consult with National Aeronautics and Space Administration (NASA) officials concerning the day-to-day field tests and proposed NASA remote sensing operations. Our field people will continue to look to Dr. Hightower and Dr. R. C. Bushland at Mission, Texas, for liaison in this area. At this time we are not considering assignment of any of our Veterinary Services personnel to NASA. We will continue to be receptive to any new techniques developed by Agricultural Research Service and NASA and incorporate them into our programs when they have been perfected to the extent that they can be used operationally.

We have worked closely with the Government of Mexico since 1947, and we continue to enjoy excellent relationships at all levels. We understand that NASA desires to cooperate in a field test in Mexico to further study remote sensing. We strongly urge that NASA obtain the necessary cooperative agreements with all Mexican Government agencies involved to facilitate the conduct of any project of this scope which will involve field, laboratory, and data analysis, along with free interchange of information from both countries.

We appreciate the fact that NASA has tremendous potential in the area of earth resources, remote sensing, and similar technological advancements. We hope that we will be able to cooperate and later

Copies to: Bushland, Hightower 9-18-73

RECEIVED
SEP 17 1973
AREA OFFICE
WESLACO, TEXAS

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WASHINGTON, D.C. 20250

14 SEP 1973

Your reference DDIZ

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Earth Resources Program Office
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas 77058

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develop methods to utilize these new resources as tools for more efficient livestock disease control and eradication program activities. We certainly appreciate the efforts that have been expended thus far by NASA officials seeking to develop a useful application of satellite-produced data and technology.

Sincerely,

E. E. Saulmon
Deputy Administrator

cc:
Mr. T. W. Edminster, ARS, Washington, D.C.-w/c inc.
Mr. E. A. Taylor, ARS, Weslaco, Texas-w/c inc.
Dr. L. Henderson, ARS, Beltsville, Md.-w/c inc.
Dr. N. L. Meyer, APHIS, Mexico City, Mexico-w/c inc.
Dr. M. E. Meadows, APHIS-VS, Mission, Texas-w/c inc.
Regional Director-South Central, APHIS-VS, Hyattsville-w/c inc.

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Dr. L. Henderson, ARS, Beltsville, Md.-w/o inc.
Dr. N. L. Meyer, APHIS, Mexico City, Mexico-w/o inc.
Dr. M. R. Meadows, APHIS-VS, Mission, Texas-w/o inc.
Regional Director-South Central, APHIS-VS, Hyattsville-w/o inc.

U.S. DEPARTMENT OF AGRICULTURE

REFERENCE SLIP

DATE 10/3/73

TO Mr. Taylor
Weslaco, Texas

- [ ] ACTION
- [ ] NOTE AND RETURN
- [ ] APPROVAL
- [ ] PER PHONE CALL
- [ ] AS REQUESTED
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- [ ] YOUR SIGNATURE

REMARKS

RECEIVED
OCT 9 1973
AREA OFFICE
WESLACO, TEXAS

FROM H C Cox, LCASR
New Orleans, La.

GPO : 1964 OF—742-059

FORM AD-514 (8-64)

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WASHINGTON, D.C. 20250

FILE: SECTION Research
SUBJECT Screwworm
FOLDER NASA

14 SEP 1973

Your reference DD12

	Cooper
2	Cox
1	Reins
	Heffpauir
	Marcley
	Bridges
	Lucy

AIRMAIL

Mr. Clifford E. Charlesworth, Manager
Earth Resources Program Office
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas 77058

Dear Mr. Charlesworth:

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E. E. Saulmon
Deputy Administrator

cc:
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Mr. E. A. Taylor, ARS, Weslaco, Texas-w/c inc.
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Dr. M. E. Meadows, APHIS-VS, Mission, Texas-w/c inc.
Regional Director-South Central, APHIS-VS, Hyattsville-w/c inc.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS 77058

REPLY TO ATTN OF: DD12

AUG 31 1973

Dr. Francis J. Mulhern
Animal and Plant Health
Inspection Service
U.S. Department of Agriculture
Room 316E, Administration Building
Washington, D.C. 20250

HOURIGAN
SCHUBERT
KLINGFORD
KNOWLES
MATHIS
SGEE

Dear Dr. Mulhern:

As you know, the Health Applications Office, L. B. Johnson Space Center, Houston, Texas is involved in a cooperative methods development project with agriculture's screwworm eradication group. The basic purpose is to determine the usefulness of remote sensing for defining the screwworm fly habitat in Mexico. A test site has been selected and it is expected that preliminary field work will begin in September 1973. We are already successfully processing satellite data with computers.

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Have staff members from your agency been designated for assignment to NASA in support of this activity? If so, we would like to begin integrating them into our work program as well as assist in any persoanl matters associated with a move to Houston. As in previous cases of agriculture employees detailed to this Center, we will be glad to furnish office space and routine clerical support for the persons selected.

As you know, we are currently working with Drs. R. C. Bushland and William Hightower, Agricultural Research Service, USDA. They have arranged for several Mexican technical persons to assist in test site activities. With USDA staff members assigned to assist in data analysis and program management in Houston, a truly competent methods development team will undoubtedly result. If we are to be of maximum benefit to the Joint Screwworm Eradication Commission, we must begin field trials coupled with satellite observations as soon as possible.

Sincerely,

Clifford E. Charlesworth
Manager, Earth Resources Program Office

U.S. DEPARTMENT OF AGRICULTURE

REFERENCE SLIP

DATE 4/3/74

TO Mr Taylor

- [ ] ACTION
- [ ] APPROVAL
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- [ ] YOUR SIGNATURE

REMARKS

FROM J W Snow

GPO : 1964 OF—742-059

FORM AD-514 (8-64)

U.S. DEPARTMENT OF AGRICULTURE

SPEED-MEMO

PART NUMBER	DATE
1	22 March, 1974

TO

W. Snow

FROM

B.G. Hightower

SUBJECT

Results of Meeting with Barnes and Forstberg, NASA, Houston on Cooperative Agreements for Remote Sensing Project-Mexico

MESSAGE (*WRITE CONCISE MESSAGE. SIGN AND FORWARD PARTS 1 AND 2 TO ADDRESSEE. RETAIN PART 3*)

The results of a conference with the above cooperators held at NASA on 21 March, 1974 were as follows:

1. Emphasis on data collecting techniques to assess changes in screwworm populations in the Veracruz-Cordoba- Huatusco area would be changed to give first priority to egg mass collections from pens of wounded animals. Second priority would be given to fly trapping. Third priority would be given to animal census, case reporting, and case-incidence surveys. Fourth priority would be given to ancillary surveys on effects of ground-sensed temperature, moisture, soil temperature, relative humidity, etc., on pupae in the soil or adults in screened cages. These last observations would be undertaken only as part-time observations as time and available technical assistance permits.

2. NASA Cooperator agreed to augment its budget to pay salaries for Ing. Salvador de la Paz and three full-time field-worker trainees. NASA Cooperator further agreed to purchase sheep, feed, fencing materials, and logistical support items other than antibiotics for treating wounded sheep. Hightower agreed for ARS to provide antibiotics as supplies were usually in stock at Mission, anyway.

SIGNATURE

REPLY (*USE THIS SPACE FOR REPLY. SIGN AND DATE. RETURN PART 2 TO SENDER. RETAIN PART 1*)

3. It was agreed that INIA personnel working under the ARS-INIA Cooperative Agreement be exhorted, encouraged, and urged to coordinate their trapping and survey efforts as much as possible with the above population studies.

SIGNATURE B. G. Hightower

DATE 22 March, 1974

FORM AD-311 (REV. 5-68)

TO

W. Snow

FROM

R.G. Hightower

SUBJECT (WITH COUNTRY, MISSION, DATE AND CONTROL NUMBER)

The results of a conference with the above cooperator held on March 21, 1974 were as follows:

1. Emphasis on data collecting pertaining to causes of mortality in sheep populations in the Veracruz-Oaxaca-Puebla area would be changed to give first priority to egg mass collections from pens of wounded animals. Second priority would be given to fly trapping. Third priority would be given to animal census, case reporting, and case-history surveys. Fourth priority would be given to ancillary surveys on climate of ground-zeared temperature, moisture, soil temperature, relative humidity, etc., on pupae in the soil or adults in artificial cages. These last observations would be undertaken only as part-time observations as time and available technical assistance permits.

2. NAS-A Cooperator agreed to augment its budget to pay salaries for Ing. Salvador de la Fe and three tuj-tlin tlah-wa-ge trainees. The Cooperator further agreed to purchase sheep, food, laboratory trials, and logistical support items other than antibiotics for treating wounded sheep. Hightower agreed for IPS to provide antibiotics as well as were usually in stock at Mission, survey.

SIGNATURE

3. It was agreed that INIA personnel working in Oaxaca, PS-1 Observatory Agreement be extended, encouraged, and urged to continue their trapping and survey efforts as much as possible with the above modifications.

Dr, Brown

+

SCREWWORM MSSN

0+

SCREWWORM MSSN

WU ISCS 1-026073A092002 04/02/74

TLX NASA JSC HOU

ZCZC 003 HOUSTON TX 02 APR 74

TLX 766650 SCREWWORM MSSN

TO SCREWWORM RESEARCH LABORATORY US DEPT OF AGRICULTURE

//PLEASE PROVIDE A COPY TO MR ED TAYLOR AGRICULTURAL RESEARCH

SERVICE REGIONAL OFFICE USDA - PO BOX 267 WESLACO TV 78596//

MISSION TEXAS

BT

UNCLAS DD12

WE HAVE BEEN INFORMED THAT INIA IS UNABLE TO PROVIDE SCREWWORM SPECIALISTS FOR WORK IN TEST SITE AS STATED IN THE PROJECT PLAN. WE STRONGLY PREFER THAT CONEE ARRANGE FOR NECESSARY PERSONNEL TO REPLACE INIA TEAM. IF THIS IS NOT POSSIBLE, WE PROPOSE THAT LOCAL MEXICAN RANCHER PERSONNEL BE HIRED AT NASA EXPENSE THROUGH LOCKHEED SUBCONTRC WITH ABASTECEDORA ELECTRICA DE CORDOBA S.A. THESE PEOPLE WOULD BE TRAINED FOR TEST SITE FUNCTIONS AND WOULD REPORT TO TEST SITE DIRECTORS. ADVISE BY CABLE IF YOU CONCUR IN THIS PLAN.

SGD C M BARNES D.V.M, PH.D. CODE DD12 SCREWWORM RESEARCH

COORDINATOR NASA JSC HOUSTON TX

NNNN

1503 EDT

+

SCREWWORM MSSN

This was agreed on at NASA last week. I do not know the purpose of this cable. If you wish, I will cable reconfirmation.

BSK

Minutes of the Meeting Held with National Council on Science and Technology (CONACYT) to Discuss the Vegetation Map of Veracruz Project

Institutions represented at the meeting:

National Commission on Outer Space
Commission on National Territories Studies.
Mexico-North American Joint Commission for the Erradication of the Screwworm.
The Biological Institute of Universidad Nacional Autonoma de Mexico (UNAM).
National Council on Science and Technology, represented by it Tropical Ecology Agency.

The meeting was opened by Dr. Arturo Gomez-Pompa, explaining that the principal purpose of this meeting was the desire by CONACYT, through its National Tropical Ecology Agency, to evaluate the project by UNAM to carry out research in the State of Veracruz to work out a vegetation map of said State in collaboration with NASA. The interest expressed by NASA to work out a map of the actual vegetation of this State has the concurrence of the Botanical Department in Veracruz of the Biological Institute of UNAM. It is thought that NASA's interest can be utilized as the best possible way to carry out this project.

Since NASA has mentioned that their interest in working out this map is connected with their studies on screwworm research, and since all of the information connected with this project has not been made sufficiently clear, this matter was referred to CONACYT to hold this meeting to obtain in greater detail the opinions of the different groups interested in a project of this nature. It was especially desired to contact those persons who have had experience in collaborating with NASA and to learn the effects of such experience from such collaboration.

Dr. Gomez-Pompa explained that interest does exist by him and his research group to carry out this project; however, he feels that such studies do not necessarily have to be carried out exclusively with NASA, but can be carried out in an independent manner.

Consideration was given that perhaps it would be convenient to have the participation of NASA in this project, but that it did not necessarily have to be carried out under its direction.

It was stated that the cooperative agreement sent by NASA essentially specified the collaboration of the Biological Institute under Dr. Arturo Gomez-Pompa, and included the possibility of having two individuals from Mexico go to Houston to acquaint them in more detail with the technologies--computer technology as well as details in working out vegetation maps based on materials and information which has been obtained through the satellites.

Personnel from the Computer Center of the Universidad Nacional Autonoma de Mexico (UNAM) were also invited since it is considered that someone in the field of computers should be sent in order to obtain more knowledge of the

techniques being utilized in resource inventory studies with remote sensing.

Dr. Villasenor of the Mexican-American Commission on the Erradication of the Screwworm spoke extensively on the current status of the projects carried out under this program, commenting on the negative and positive points of such project, and emphasizing on some of the problems that should be taken into consideration in future agreements with NASA. Among the most important points stated by Dr. Villasenor was the fact that once these agreements were finalized and were executed, they were not necessarily complied with by the personnel from NASA. This especially applies when scientists who are connected in one way or another with the projects enter into Mexico but little is known of their projects or programs. He gave some very clear examples on these problems; one was in relation to some new insecticide trails held in Tamaulipas, and another was in relation to the possibility of having Mexican pilots participate in flights for NASA projects. In both cases there were problems which caused confusion and in the end, very little information was available to Mexico in this respect. He emphasized the necessity of having better national communications among the different interested groups and the necessity of carrying out a more efficiently coordinated research program.

Dr. Gomez-Pompa thanked Dr. Villasenor for his comments and indicated that this was precisely the things they needed to know in order to avoid falling into similar problems.

Dr. Martin del Campo commented on some events connected with the Agreement which was signed with Mexico and further commented that it would be well to make known to the parties of the Agreement, and especially to the Department of Exterior, all the abnormalities derived from these problems in relation to the activities of the foreign scientists in Mexico.

He indicated the growing necessity on the part of Mexico to have certain control concerning the activities of the foreign scientists in Mexico; however, he also expressed concern over the difficulty involved in carrying out a plan of this nature.

Dr. Gomez-Pompa mentioned that this aspect is very important and has been considered with great preoccupation by the National Council of Science and Technology with their different offices, agencies and departments. He stated that the group of investigators under his supervision in the remote sensing program have received offers of collaboration on similar projects from various universitites in the United States relating to remote sensing applications for inventory of natural resources. It was mentioned that it would be very important to have standard policies for consideration of all solicitations which are of interest to Mexico.

Ing. Higuera Mota of the National Commission of Outer Space presented the Commission's points of view and indicated it would be very advantageous for any technician involved in remote sensing programs or investigations of this type to learn what is being conducted in Mexico in this respect; and for this reason, the National Commission of Outer Space is offering some courses in this regard and is actually carrying on a training program to train Mexican technicians in this type of methodology. He stated that if there have been coordination problems in the past, many of these problems can be explained, and that what is more important is to bear in mind the need for

effective coordination since there exists the signed agreement between the National Commission of Outer Space and NASA, and it would be very desirable to have any other similar agreement fall within this general agreement.

Ing. Higuera Mota offered all kinds of assistance by his agency for this new project connected with the studies of vegetation in Veracruz.

Dr. Martin del Campo commented that a distinction be made betweeen projects and specific research programs dealing exclusively in the service phase, since in the case of the National Commission of Outer Space the basic service which they offer is in relation to obtaining information, data, photographs, flights, and the training of technicians, which does not necessarily relate directly with specific research programs which he feels should maintain their individuality.

Ing. Hector Alonso, representative from the Commission on Studies on National Territory, indicated that he has been pursuing with a great deal of interest the development of the investigations on the earth's resources being conducted by NASA with their satellites, and they are interested in collaborating or participating in projects of this type. He manifested he would like to know which is the specific project of NASA for Veracruz with the purpose of considering their possible participation.

Dr. Gomez-Pompa said that his agency's position in respect to NASA is that the research project concerning the vegetation map of Veracruz should be a totally Mexican project. This proposal shall be presented to NASA in order to explore their degree of participation and collaboration, knowing that actually they are interested. Nevertheless, he emphasized that this should be a factor to guide their work towards the future because the priorities given to international cooperative research programs should be in conjunction with Mexico's interest and projects, and not to the contrary. In the meantime, during the following weeks a detailed proposal shall be worked out to carry out this project, as soon as the possibilities are known for participation of other Mexican entities, organizations, institutions, or individuals. This proposal shall be presented to NASA. He also indicated that the possible collaboration with NASA should be with the object of obtaining some benefit from the participation, and such benefit might be the obtaining of information and new methods and techniques in this field.

The representative from the Commission on Studies of National Territories, Ing. Hector Alonzo, indicated that his agency would be very interested in participating in this project even though Veracruz would probably not be photographed until next year; nevertheless he indicated that they are very willing to actively participate during any stage of the project.

Ing. Higuera Mota from the National Commission of Outer Space concurred with this proposal and stated that the proposal could be presented at the next InterSecretarial Meeting to the different Secretaries of State to determine their interest in the project and also attempt to obtain greater collaboration or interest from other government agencies.

Dr. Gomez-Pompa stated that there definitely exists interest by various Secretaries of State and Commissions, such as the Federal Electric Commission of the Laguna Verde Project in Veracruz, the Office of Hydraulic Resources in the north and south part of Veracruz, as well as the Commission on Papaloapan having jurisdiction of all of the area covered by the Papaloapan River basin, which involves a great part of the State of Veracruz.

There were several discussions concerning the clearing up of some points in order to be able to carry out the project, and discussions on the importance of coordinated efforts in this field. A suggestion was made for weekly meetings in order to analyze the different projects and current status of the cooperative research programs with NASA. There were different opinions on this--for and against it. It was decided that the next meeting would be held for the presentation of the proposal on the vegetation map of Veracruz and at that time dates would be set to discuss some of the specific research problems.

It was agreed to hold a meeting with CONACYT to evaluate the screwworm research work that is being carried out in Mexico by the National Tropical Ecology Agency. This agency could take charge of coordination of this type meetings, overseeing that the different interested groups on this matter are contacted. It was suggested that a meeting be held as soon as possible to evaluate the current screwworm research situation and the participation of the Mexican institutions in said program.

All agreed to a next meeting with anticipation and the representative to be contacted for the National Council of Science and Technology would be Dr. Jorge A. Vargas from the Office of International Affairs. There being no further business, the meeting adjourned.

Mexico, D. F., October 18, 1974.

Dr. Arturo Gomez-Pompa

Dr. Enrique Martin del Campo

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UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
VETERINARY SERVICES
WASHINGTON, D.C. 20250

Subject: Remote Sensing - Mexican Screwworm Eradication Program

NOV 5 1974

To: Howard Hill
Project Leader
Foreign Agricultural Service

Through: David L. Hume, Administrator
Foreign Agricultural Service

This is in reply to a series of questions on the planned operational uses of ERTS data, which you furnished to the screwworm staff of Veterinary Services. These questions covered program uses of the information, resources, savings and benefits, alternative sources of information, and data and system characteristics requirements.

Answers to questions in the above categories are being sought in a research effort by scientists from National Aeronautics and Space Administration (NASA) and from Agricultural Research Service (ARS). They are attempting to determine the technical and economic feasibility of using remote sensing as a tool in the screwworm program. Scientists from NASA are optimistic and enthusiastic about the possibilities that remote sensing holds for screwworm eradication work. Scientists from both Animal and Plant Health Inspection Service (APHIS) and ARS believe that the use of satellites in conjunction with the screwworm eradication program is a proper area for research and the whole concept has not yet progressed far enough along to be given to APHIS as an operating tool.

The basic thrust of the ARS-NASA work towards the use of satellites in the screwworm eradication program may be generally divided into two parts. The first part is taking place in a test site near Cordoba, Veracruz, Mexico, where representatives from NASA and cooperating agencies are attempting to collect ground-truth data. This data is collected from within the test site on temperature and moisture conditions for correlation with screwworm incidence. Ground-truth information on temperature, moisture, and other environmental conditions will be compared with information received from a satellite.

The second thrust of the research is the construction of a screwworm population model which will be used to help predict screwworm outbreaks. It is our understanding that it may take several years to produce a

Jc to Johnson 11-11-74

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AREA OFFICE
WESLACO, TEXAS

thoroughly reliable model. We understand that NASA has been working on this, and that they will have a preliminary model available sometime in February 1975.

We are unable to give specific answers to the questions since research on the technical and economic feasibility of using satellites in screwworm work has not been completed.

/s/ Pierre A. Chaloux

Acting Deputy Administrator
Veterinary Services

cc:
E. A. Taylor, ARS-Southern Region, Weslaco, TX

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/s/ Pierre A. Chaloux

Acting Deputy Administrator
Veterinary Services

cc:
E. A. Taylor, ARS-Southern Region, Weslaco, TX

Not yet approved

LIFE SCIENCES DIRECTORATE

TECHNICAL SUPPORT

Support for Health Applications Office

Screwworm Interdisciplinary Team — Responsible for the practical analysis and use of satellite data in support of screwworm eradication. Personnel requirements follow:

1 — Ecologist, Work Coordinator, (doctorate in a biological field, work in ecology; Thiermann) — Coordinates the work of the various specialists in support of screwworm eradication; technical responsibilities in the correlation of screwworm infestation with variables which can be sensed remotely, as well as in the field ecology of the Mexican test site.

1 — Meteorologist (MS) — Coordination of meteorological data from test site and other areas with NOAA satellite data, an interactive task with personnel at the test site.

1 — Entomologist (Ph.D.) — Responsible for coordination of entomological and ecological data with weather data.

1 — Botanist (Ph.D.) — Primarily responsible for preparing surface cover maps on the basis of ERTS and aircraft data.

Local Support Team — Arrange acquisition of data; provide on-call expertise to screwworm projects as needed; develop the shellfish contamination project; develop the emergencies-disasters project; and develop the many other projects of the Health Applications Office.

1 — Computation Specialist (equivalent of MS in math) — Facilitates reception and conversion of satellite data to usable forms.

1 — Earth Scientist (MA in oceanography, geology, geophysics, or related field) — Primary emphasis on water degradation; secondary emphasis on soil wetness, air degradation, water remaining during drought, etc.

1 — Support Scientist in Meteorology-Climatalogy (Advanced degree and scientific maturity; Barger) — Supports meteorological aspects of all projects.

1 — Physical Scientist, engineer, or advanced technician (BS or equivalent) — A generalist to work mostly on the emergencies-disasters project.

1 — Support Scientist in Biological Sciences (advanced degree in epidemiology or similar field, with scientific maturity) — Consult on health aspects of all projects.

0 — Support Scientist in Physical Sciences (see Supervisor, below)

Support Services

1 — Supervisor, scientist (Ph.D. in a Physical Science, scientific maturity; Giddings) — Technical direction of work, consultation on physical aspects of all projects, actual working participation in projects.

1 — Secretary, preferably bilingual

Technical report editing and illustration will be done by the LEC Technical Publications Pool. Computer engineers and technicians or support for mosaicking, photo interpretation, or similar tasks when needed will be by support service requests to existing organizations.

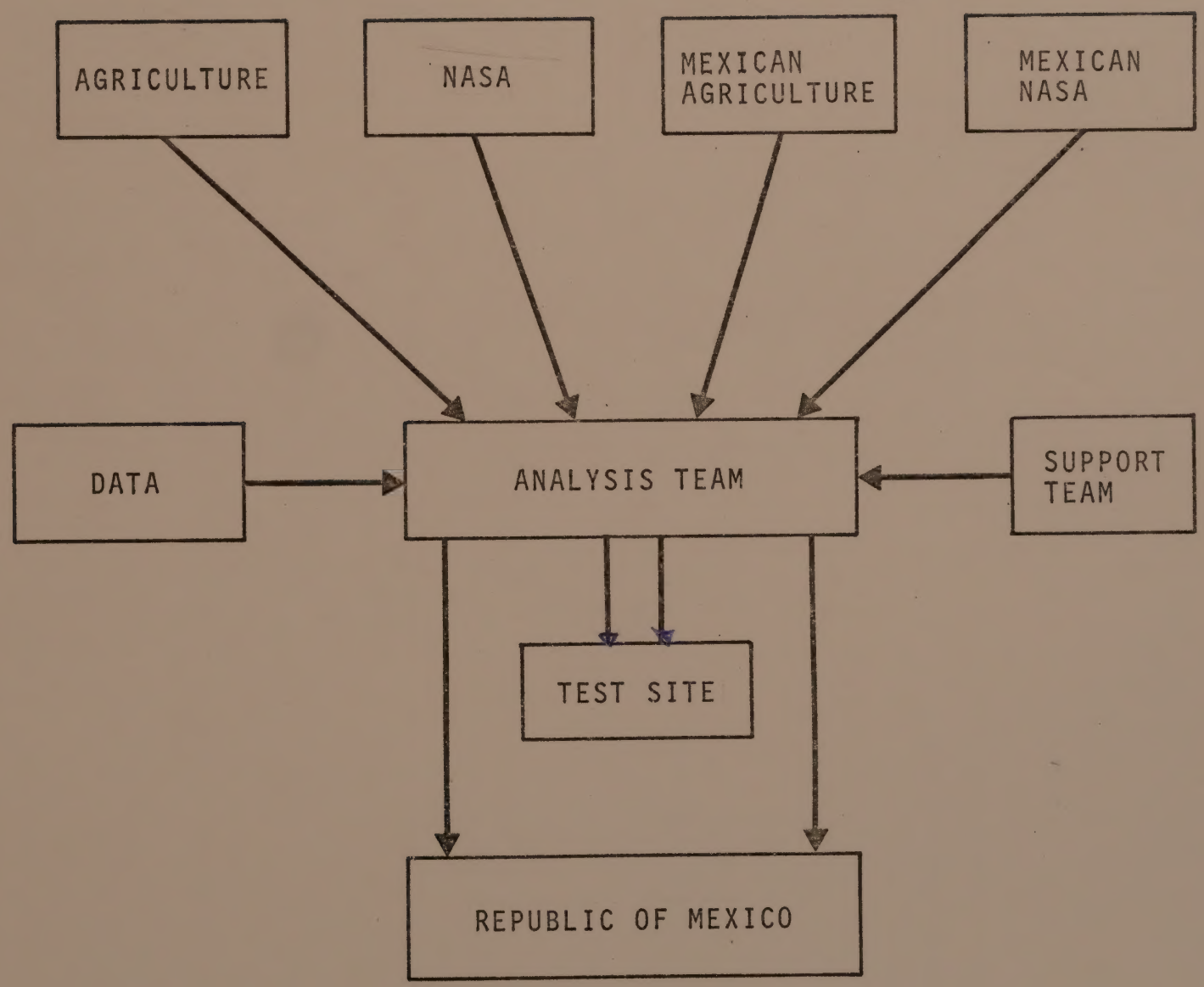
1-1/2 — Technical Writer, Illustrator, and Typist (MYE)

1 — Computer Engineer or Technician, or similar skills (MYE)

1 — photo interpreter (MYE)

Material — 8K

Travel: 12 K


AGRICULTURE
NASA
MEXICAN AGRICULTURE
MEXICAN NASA
DATA
ANALYSIS TEAM
SUPPORT TEAM
TEST SITE
REPUBLIC OF MEXICO

1973

	JAN	FEB	MAR	APR	MAY	JUN
Commence test site inventory	^					
Write specifications for weather equipment needed for the 20 Mexican weather stations.		^				
LTR from International affairs to republic of Mexico authorizing liaison.			^			
Order specified equipment.			^			
Ship equipment to American Embassy in Mexico				^		
Order ERTS data to cover site.				^		
Meet with International Affairs and establish liaison with Mexican Space Agency				^		
Get official permission and work permits for Mexico; for American personnel				^		
Build weather station shelters in the Veracruz area.				^		
Assign Mexican National on equipment placement				^		
Transport equipment from Embassy to test sites and proceed with a calibration and operation evaluation.				^		
Identify and define each station location				^		
Contact local ranchers and establish infestation report procedures and weather station locations.				^		
Hire and train Mexican Nationals for test site caretakers.					^	

1973

	JAN	FEB	MAR	APR	MAY	JUN
Define test site reporting procedures.					^	
Establish communication linkage between test areas and Houston.					^	
Activate Veracruz and Tampico test sites.					^	
Estimate requirements for aircraft overflight.						^
Proceed with an aircraft inventory of the test site.						^

Note: All subsequent dates time phased to this event. For example, a slippage of this date of two weeks results in two weeks slippage of all following events.

Ecologist, work coordinator

This scientist will coordinate the contributions of the various specialist of the interdisciplinary team. He will have technical responsibilities in the field of ecology of vector-borne diseases, concentrating on those diseases whose ecological factors can be sensed remotely. He will also contribute to public health aspects by utilizing remotely sensed data of air and water degradation. He will relate animal health conditions to vector and reservior habitats. His technical contribution to the screwworm eradication program will mostly consist of studies of fly population changes that can be related to remotely sensed variables.

Meterologist

This scientist will be primarily concerned with predicting ground meterological conditions for the screwworm eradication project on the basis of satellite data. Data for his use will include both high and medium resolution infrared and visible images of the earth and clouds on magnetic tape, perhaps low resolution microwave images of the earth, and temperature profile information from satellites, as well as standard meteorological measurements from small ground stations. He will direct the taking of additional meteorological ground truth data such as surface radiation temperatures, which may be necessary for the interpretation of satellite data. He will emphasize the measurement of variables which can be used by other specialists in predicting infestation of screwworms. His work will be highly interactive with persons taking meteorological measurements in the screwworm test site.

Meteorologist

This assistant will be primarily concerned with predicting ground meteorological conditions for the satellite evaluation project on the basis of satellite data. Data for this use will include both high and medium resolution infrared and visible images of the earth and clouds on magnetic tape, perhaps low resolution microwave images of the earth, and temperature profile information from satellites, as well as standard meteorological measurements from small ground stations. He will direct the taking of additional meteorological ground truth data such as surface radiation temperatures, which may be necessary for the interpretation of satellite data. He will emphasize the measurement of variables which can be used by other specialists in predicting interaction of microwaves. His work will be highly interactive with persons taking meteorological measurements in the microwave test site.

Entomologist

This scientist fill focus his studies on those diseases caused by insects or by agents ecologically related to insect vectors. He will relate thses vectors and their activities to physical and chemical characteristics of the environment which can be monitored with remote sensing tools. He will also be responsible for the traditional entomological tasks, such as identification and classification of insects in field work. He will provide entomological expertise for consultation by other specialists and he will cooperate in definitions of test site ecology.

Botanist

This scientist will provide expertise in botany and botanic taxonomy. His competence will be applied to studies of the disease vectors which have some sort of dependency to specific vegetation. He will elaborate phenological observations, and construct plant species maps which can be related to disease or disease vectors. He will construct vegetation coverage maps of test areas on the basis of satellite and aircraft images; these maps will assist in meteorological and ecological studies. As consultant to other specialists he will suggest optimum times for overflying test sites from the point of view of plant coverage, and as coworker he will study the interdependence of plant and insect ecological niches.

Computation Specialist

This scientist/engineer will be responsible for coordinating with other agencys and directorate personnel data requirements, formats and for insuring that the satellite data specified is compatible with computer processing facilities at JSC. He will establish requirements and assist in the performance of all non-interactive computer transformations of these data. He will also assist other specialists in interactive manipulations of the same data. He will insure that the final forms of data are useful to persons not familiar with computors. Some final forms of data will be symbol density maps, images, map overlays, and false color-enhanced images of screwworm eradication areas.

Conservation Specialist

This extensive guidance will be invaluable for coordinating with other agency and directorate personnel data requirements formats and for insuring that the particular data specified is compatible with computer processing facilities at GSC. We will maintain requirements and assist in the performance of all pertinent interactive computer transformations of these data. We will also assist other specialists in interactive manipulations of the same data. We will insure that the final forms of data are useful to persons not familiar with computers. Some final forms of data will be spread sheets, graphs, maps overlays, and false color-enhanced images of sagebrush classification areas.

Earth Scientist (Oceanographer, geologist, geophysicist, or related specialty)

The earth scientist will focus on the various problems of the earth's surface and water bodies which relate to the public health. He will measure soil wetness from diurnal temperature lag. He will determine pollution effluent currents from rivers along the gulf coast. Using ERTS data he will locate and measure water bodies that survive the dry season in the northern part of Mexico. He will also assist in planning aircraft overflights to assure that usable data will be obtained for his projects.

Support Scientist, Meteorology - Climatology

A scientist with great professional experience in a wide variety of global environmental projects who will assist in establishing lines of communication or liaison with other agencies expecially in the field of meteorology and climatology. He will play a key role in supporting the screwworm interdisciplinary team especially concerning proper placement of small stations, correlation of ground truth with satellite data, and inferences of meteorological data from satellite data. He will also maintain liaison with national meteorology and space commissions of countries involved in operations of the Health Applications Office. He will act as senior advisor to professionals in the physical sciences. (Dr. Bargar)

Physical Scientist (bachelor level)

A senior scientist/engineer who will devote his energies to the emergencies-disasters project. He will develop an appropriate photomanual of Houston streets from existing aircraft photographs; the manual is to demonstrate its usefulness for real-time routing decisions during emergencies. He will also develop and test the concept of teams of specialists from several remote sensing disciplines, to lend assistance as needed during disasters such as earthquakes, hurricanes, and major fires. He will develop a manual of procedures detailing duties of each member of such a team, and, if feasible, will man an actual team for immediate duty during disasters.

Epidemiologist

This scientist will develop and direct programs of research relating diseases to environmental factors. He will concentrate on diseases relating to environmental factors which are amenable to remote sensing and which are significant to the public health. He will relate human and animal health conditions to disease vector and reservoir habitat, environmental ranging, transmission mechaninisms, susceptible host populations, diurnal and seasonal cycling. In addition, he will act as consultant in all biologically related fields of the HAO, serving as senior advisor to professionals in these fields.

Physical Scientist - Supervisor

He performs normal supervisor sign off and approval of contract support. In addition, he coordinates and provides technical direction of the work of the various specialists in the diversified projects of the section. He serves as a specialist in all phases of physics and chemistry involved in the project, such as the interaction of solar radiction with the earths atmosphere and surface, the radiation budget of the earths atmosphere, properties and appropriateness of sensors, and similar topics. He will assist in the definition of aircraft and ground truth mission accomplishments, and define experiments that may be necessary to interpret field data.

Secretary

The secretary will handle traditional lines of clerical and secretarial work. In addition, she should be a competent technical typist, and be able to type in Spanish.

ABSTRACT

A PROPOSAL FOR A FEASIBILITY TEST OF THE USE OF REMOTE SENSING IN SCREWWORM ERADICATION

This document contains a National Aeronautics and Space Administration (NASA) proposal concerning the use of remote sensing technology to support the U. S. Department of Agriculture (USDA) in its program of eradication of the screwworm fly. The current USDA program is directed at preventing reinfestation of the United States, which was cleared of overwintering populations of the fly in 1966. A future planned program includes fly eradication in a large part of northern Mexico.

As a prelude to the program, the NASA proposes to examine in concert with USDA, the feasibility of using remote sensing in the eradication effort. Studies would be limited to a defined test site within Mexico. Remote sensing would provide detailed environmental data of the test site. Simultaneous ground studies would relate insect ecology to collected sensor data. An analysis would determine the usefulness of remote sensors for detection of environmental factors conducive to the growth of insect populations. If test site studies are successful, such information could lead to a cost effective climatology system required for the major screwworm eradication effort. The basic science developed could lead to useful application in eradication of other insect pests which have similar morphological characteristics as the screwworm fly.

A PROPOSAL FOR A FEASIBILITY TEST OF THE USE OF REMOTE SENSING IN SCREWWORM ERADICATION

1. General

a. The screwworm fly has infested the tropical and temperate zones of North and South America and caused serious losses to livestock and wild animal life for over 125 years. The infested area extended from South Central Argentina and-Chile as far north as Nebraska. The insect causes losses to warm blood animals by laying eggs in any open wound, no matter how small. The eggs hatch into larvae which eat deeply into the wound. If not detected and treated, the infected animal may die in a few days. Even after treatment the animal may be stunted, make slow weight gains, and be more susceptible to infection. The end result is increased cost of production, reduced income to ranchers and dairymen. In Latin America an additional problem is the simple fact that the result is a loss of an irreplaceable protein resource which is vital to human health.

b. Detection and treatment remained the only remedy to the problem until the late 1930s when a theory concerning the use of sexually sterile flies was developed. It was based on the fact that the female fly breeds only once in the life cycle. It was therefore theorized that if sterile male flies could be produced and seeded in the infested area for several generations, the fly population would disappear.

c. The theory was of minor practical value until 1951 when Cobalt-60 radiation sources were developed which provided a practical method of irradiating the larvae to produce sterile flies.

2. The Eradication Program in the United States

a. The eradication program in the United States was developed and carried out by the U. S. Department of Agriculture. The first area to be attacked was the Southeastern United States. Sterile flies were produced and distributed in the area by aerial seeding carried out by light aircraft. The problem was eliminated in the Southeast by 1959.

b. A similar program was launched in the Southwest United States in 1962. Sterile flies were produced at a new production facility at Moore Field, Mission, Texas, which was capable of producing 150 million flies per week. By 1966 the screwworm fly was eliminated from the United States.

c. The total cost of the eradication project in the United States was approximately 25 million dollars. It is estimated that the savings to the cattle and dairy industries amount to 120 million dollars annually.

3. The United States Barrier Program (Figure 1)

The elimination of the fly from the United States required a system for insuring against reinfestation from Latin America. To accomplish this task the Department of Agriculture together with the Mexican Government has established a barrier along the United States/Mexico border

extending into Mexico in some depth. In this barrier area sterile flies are continually seeded and ground checks made periodically by agents of a joint Mexican-American commission for the control of screwworms and by residents of the area to detect evidence of reinfestation. "Hot spots" are then heavily seeded to restrict the spread of the insect and to eliminate its source. This program is supported by the sterile fly production plant at Mission, Texas, and by aircraft assigned to the Department of Agriculture. The cost of the barrier is five million dollars annually and it must be maintained indefinitely unless Mexico is cleared.

4. The Mexico Eradication Program

a. A Mexico/United States survey to determine the feasibility of a screwworm eradication program throughout Mexico has been completed. A favorable report has resulted in a detailed program prepared by the United States Department of Agriculture. The project is proposed as an item in the Department's FY 1973 budget. It is estimated that the program will require four years, with the first year devoted to construction of a new production plant in Southern Mexico or equipping a facility aboard a ship. Seeding operations will then continue for two years, with the fourth year devoted to assessing results. The two year seeding period may be reduced considerably if techniques currently under study prove successful.

b. Once Mexico is declared free of the fly the current (United States/Mexico border) barrier will be suspended and a new barrier activated in Southern Mexico.

5. Use of Remote Sensing

a. General

During the past few years a program has been underway to develop earth survey techniques utilizing remote sensing from aircraft and from spacecraft. Resources which have been surveyed in this manner include definition of geologically important areas, coastal and estuarine areas, soils and soil moisture, crops, timber, land use, watersheds, sea state, transportation networks, etc.

b. What is Remote Sensing?

Remote sensing may be thought of as the gathering of information without actual contact with the object or area being investigated. The earth observations instrumentation which gather such information take advantage of the physical principle that all materials radiate or reflect electromagnetic energy and the radiant spectrum is unique for each material making it identifiable. Spectral regions which have received primary attention for earth resources work include the ultraviolet, visible, infrared, and microwave. Advanced photographic techniques are emphasized in the visible range; radiometers, spectrometers, and multispectral

scanners in the ultraviolet, infrared; passive radiometers, scatterometers and side-looking imaging radars in the microwave region. Data accumulated from these sources indeed give the scientific investigator "new eyes" in observing man's environment. While these new methods are in their infancy when used in applications to earth's problems, they are proving cost beneficial in several instances.

c. Remote Sensing in Public Health Application to Insects

During recent months considerable effort has gone into a new program of the use of remote sensing to define environmental conditions which contribute to the degradation of human and animal health. A major subject of study has been that of insects and arthropods important to man's well being. This has included one small project to study the ecology of the screwworm fly as a model for all pupating insects. From this preliminary survey it is believed that remote sensing can contribute materially toward understanding environmental conditions where this insect thrives. However, it is also evident that insufficient scientific information is available concerning the total environmental requirements for this particular insect. While some data is available in the literature such as optimum soil temperature desired by the pupal stage, a comprehensive ecological model must be further developed. For this reason it is believed that remote sensing and appropriate ground studies in a small test area is mandatory prior to initiating aircraft operations in support of a major eradication effort.

6. Climatology and the Screwworm Fly

a. Background

The USDA proposal to eradicate the screwworm fly from Northern Mexico is an ambitious project. However, in the southern and southwestern United States, it has been shown that by utilizing aerial drop technique vast areas can be covered quickly and liberated from this insect pest. In these eradication campaigns considerable gain was acquired by taking advantage of weather and climatological conditions which limited and defined more precisely the affected zone. In the first Florida campaign an unusually severe winter killed numerous insects and suggested that the program be initiated some months previous to planned sterile insect releases. In Mexico, weather conditions should be more stable. Instead of temperatures increasing in the spring latitudinally from south to north as in the southern United States, it is affected primarily by changes in altitude. the terrain varies from the tropical lowlands to a central plateau and extends to numerous high mountain peaks. Several major canyons and river valleys complicate the climatology as their waters flow from the central highlands to the coast.

Another factor which influences the insect life cycle concerns the predominance of rainy and dry seasons in much of Mexico. The eradication campaign planners will undoubtedly take advantage of these seasonal ground moisture conditions which may preclude the development of insect pupae.

When working in the United States, planners received data from numerous weather stations available from the Weather Service. In addition, there were reports of soil moisture and other factors relating to crop production routinely reported to USDA. Within Mexico, the number of weather stations is materially reduced and climatological data reported from other sources is minimal.

From the above discussion it is reasonable to assume that additional detailed climatological data throughout Mexico is not only desirable but necessary to improve the cost effectiveness of the eradication program. Since it appears unlikely that sufficient detailed field reports will be available for planning purposes it will be necessary to either increase the number of observation points or to use some other method of gaining such information. Remote sensing technology might logically provide this data in a convenient format for operational use.

7. NASA Proposal

a. Test Site

It is proposed that NASA technology concerning the use of remote sensing be utilized to determine local climatology in a test site within Mexico. The test site would be selected for its varied altitude and environmental conditions which are conducive to the growth and study of the screwworm fly. It will be situated south of the current screwworm barrier drop zone to preclude the effects of sterile fly release on the naturally occurring population.

The USDA (Mexico City Office) has proposed a test site somewhere along Highway 86 between Ciudad Valles, Tps., and Rio Verde, S.L.P. (Figure 2). Final selection can be accomplished in the near future.

It is proposed that NASA aircraft overfly the test site prior to initiating detailed ground studies on the test insect. Additional overflights and collection of remotely sensed data would be undertaken at appropriate intervals as determined by the project manager and based primarily on data returned from the entomological and/or climatological ground truth team. Final analysis of test site results will determine the feasibility of its use in the major screwworm eradication campaign.

It is proposed that the test site also be the subject of ad hoc investigation by means of the Earth Resources Technology Satellite (ERTS). Staff members of the Health Applications Office, NASA, MSC, will be responsible for review of ERTS coverage of Mexico as it becomes available. It is anticipated that ERTS data will provide a fair amount of climatological information useful in the overall evaluation. Since the screwworm fly is a vigorous insect ranging over several miles in the course of his lifetime it is possible that ERTS material may be of sufficient resolution that aircraft data will not be required or its use may be materially curtailed.

b. Remote Sensing Instrumentation

The basic question to be answered if remote sensors are to be used is what are the highly reliable parameters that can be observed which relate to the environment of the screwworm. From previous experience, the factors that strongly influence the screwworm fly population are soil moisture, temperature, and vegetative cover. These items may be influenced by latitude and, in Mexico, variations may be affected primarily by altitude.

The basic types of aircraft remote sensing instruments to be used for measuring and recording the soil moisture, temperature, and vegetative cover are summarized in Figure 3 and spacecraft instrumentation in Figure 4.

c. General Working Arrangements

(1) A U.S. inter-agency working group (Figure 5) will be continued to complete technical details of the proposed joint effort to determine the feasibility of the use of remote sensing to assist in eradication of the screwworm fly.

(2) A general plan for organization is proposed in Figures 6 and 7.

(3) The Office of International Affairs, Headquarters NASA will coordinate with the Department of Agriculture and State to lay the necessary ground work for a cooperative international program between Mexico and the U.S. as described previously. They will attempt to expand current arrangements of the joint Mexican-American Commission for the Control of Foot and Mouth Disease and the Screwworm Fly (Figure 7) to include provisions for remote sensing as an adjunct effort. Due to the technical expertise in the U.S. Earth Observations Program it is expedient to assume that U.S. aircraft, spacecraft, and data processing facilities will be utilized in the test program. In this case it is highly desirable that appropriately trained Mexican nationals be invited to participate in total technical management of the remote sensing program. This might include entomology experts from the research staff of the Secretaria de Agricultura as well as remote sensing staff from the Exterior Space Commission. The Mexican Defense Ministry would necessarily become involved in the case of aircraft overflight. Working space for a small contingent can be arranged at the Manned Spacecraft Center.

(4) Upon completion of general agreements between the two countries there will be formed a Mexican-American Coordination Group (Figure 6) to promote harmony in the day to day operations of the program, to favorable publicize the results of goals achieved in the joint effort, and to contribute toward further programs between the two nations as appropriate.

(5) The day to day operational management of the remote sensing portion of the test site program is conceived primarily as a function of the Health Applications Office, (Health Services Division, Life Sciences Directorate, Manned Spacecraft Center, NASA) located in Houston, Texas.

This office is colocated within the Earth Observations Division, (Science and Applications Directorate) at the same center. From this position, health related functional programs are conducted and supported by the entire staff including aircraft and data processing facilities. Appropriate staff members of the U.S. and Mexican governments should be invited to participate in routine management of field operations and analysis as members of the Remote Sensing Operations Team. In this way the necessary interface can be maintained between cognizant agencies. If resident, on site participation cannot be arranged, regular meetings must be held to coordinate the various aspects of the program.

(6) NASA proposes to furnish jointly with the Mexican space agency through contractor support arrangement, some technical and scientific staff to complement the research effort within the test site (Figure 6). Specifically it proposes to provide the expertise required to accumulate "ground truth" information necessary to understand data gathered by aircraft or spacecraft. Operation of the test site would be the responsibility of the joint Mexican-American Campaign for Control of the Screwworm Fly which is now in existence as a sub effort of the Mexican American Commission for the Control of Foot and Mouth Disease. Further details on organization, personnel, and support will be resolved in meetings of the interagency task force and by agreement with the joint Commission.

d. Costs

(1) It is proposed that the costs of the feasibility tests be the joint responsibility of the affected agencies of both governments. Operation of the ground test site could be adjucated the same way as that currently being conducted by the joint Campaign for the Control of the Screwworm Fly. NASA (MSC) has already budgeted for some technical assistance to ground truth support for the test site.

(2) It is proposed that if U.S. aircraft and/or spacecraft are used, costs supporting the feasibility test operations be borne by NASA as well as data reduction and processing costs.

(3) The Mexican government should be asked to provide staff support and travel funds for those members assigned to work at the Houston project office. NASA can supply necessary work space and office supplies to support routine work requirements.

(4) Unanticipated costs are expected to be shared on a 50 - 50 basis or approved by participating agencies of the governments concerned.

(5) USDA is encouraged to detail sufficient technical staff to NASA (MSC) Houston to support routine operations of the Remote Sensing Operations Team and the test site within Mexico. Office space and routine support can be arranged within the Health Applications Office.

THE CURRENT U.S./MEXICAN BORDER BARRIER

FIGURE 1

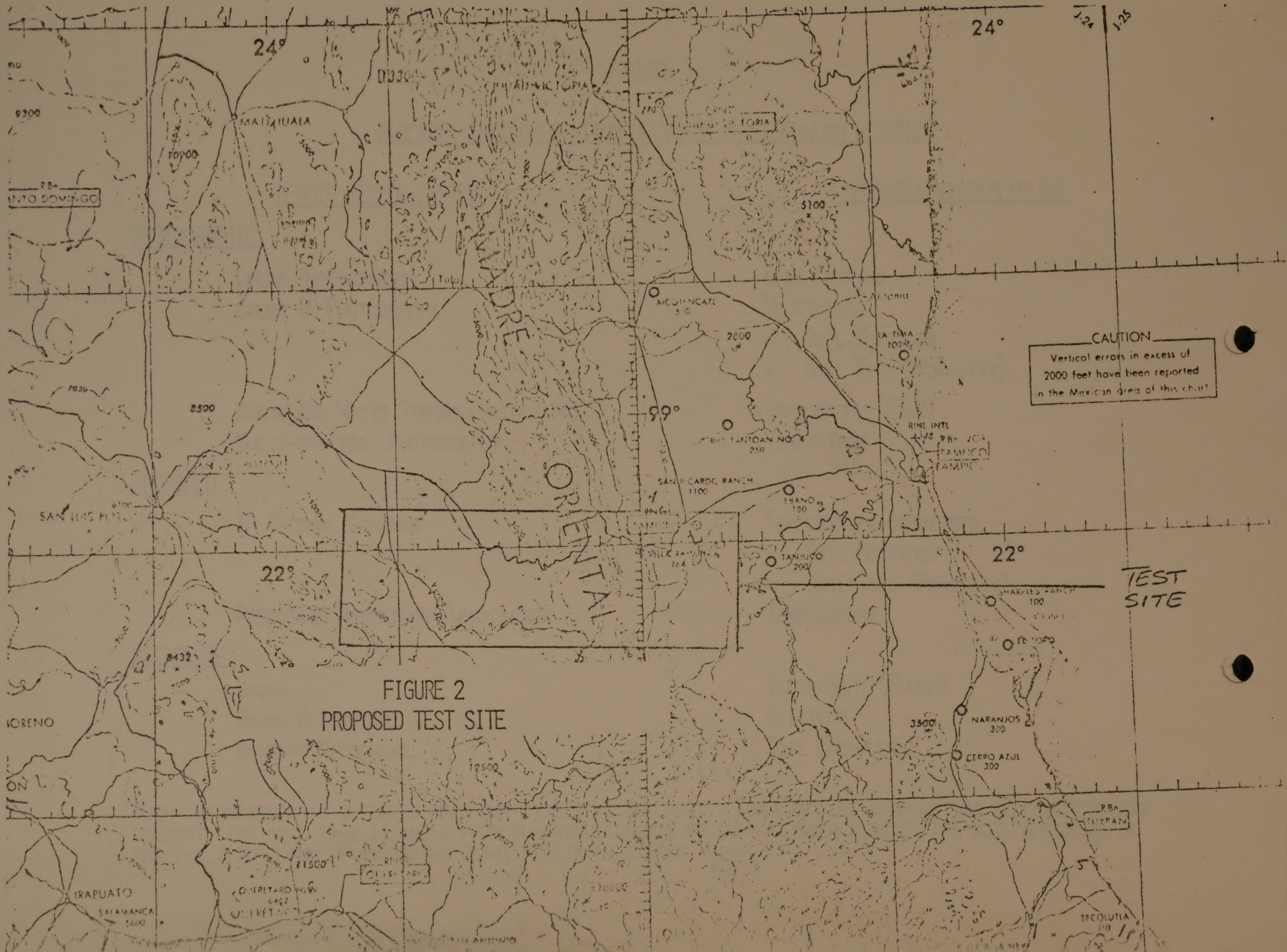


FIGURE 2
PROPOSED TEST SITE

FIGURE 3.

AIRCRAFT INSTRUMENTATION OF VALUE IN SCREWWORM RESEARCH

REMOTE SENSOR SYSTEM	MEASUREMENT/DISCIPLINE
PHOTOGRAPHIC	
COLOR PHOTOGRAPHY	BASE MAPPING
COLOR IR PHOTOGRAPHY	VEGETATION ∘ SOIL MOISTURE ∘ SOIL TYPE (POROSITY)
BLACK AND WHITE STEREO PHOTOGRAPHY	TOPOGRAPHY (FINE)
MULTI-SPECTRAL PHOTOGRAPHY	VEGETATION
INFRARED	
IR THERMAL SCANNER	TEMPERATURE GRADIENTS ∘ SOIL MOISTURE ∘ SOIL TYPE (POROSITY)
PRECISION RADIATION THERMOMETER	TEMPERATURE
MICROWAVE	
RADAR	TOPOGRAPHY (ROUGH)
RADAR ALTIMETER	ALTITUDE
PASSIVE MICROWAVE	SOIL MOISTURE

MUCH INFORMATION IS INFERRED FROM THE DIRECT MEASUREMENT. FOR EXAMPLE, KNOWING THE TYPE VEGETATION PRESENT, THE SOIL TYPE IS KNOWN FROM THE REQUIREMENTS TO SUPPORT SUCH PLANTS, THE SOIL MOISTURE IS PARTIALLY INFERRED BY ASSESSING PLANT HEALTH OR STRESS.

FIGURE 4.

ERTS INSTRUMENTATION OF VALUE IN SCREWWORM ENVIRONMENT RESEARCH

RETURN BEAM VIDICON (RBV)

No. 1	.475	.575
No. 2	.580	.680
No. 3	.690	.830

MULTISPECTRAL SCANNER (MSS)

CHANNEL 1	.5	.6	
CHANNEL 2	.6	.7	
CHANNEL 3	.7	.8	
CHANNEL 4	.8	1.1	
CHANNEL 5	10.4	12.6	(ERTS B ONLY)

(INSTANTANEOUS FIELD OF VIEW 260 FT. X 260 FT.)

FIGURE 5.

AMERICAN

INTER-AGENCY WORKING GROUP

NASA

COGNIZANT STAFF:

HQ	DR. A. PARK	ER
	DR. A. RYAN	MM
	MS. C. ANDREWS	I
MSC	DR. C. BARNES	DD121
	MR. R. MACDONALD	TF

GSFC

USDA

COGNIZANT STAFF:

DR. ROBT. H. MILLER	ARS (SOUTH BLDG.)
~~MR. JOHN FLUNO~~	~~ARS BELTSVILLE~~
MR. DICK FELCH	USDA WEATHER
DR. DON WILLIAMS	APHIS HYATTSVILLE
DR. M. E. MEADOWS	APHIS MISSION, TX
DR. A. HEFLIN	APHIS MEXICO, DF

FIGURE 6.

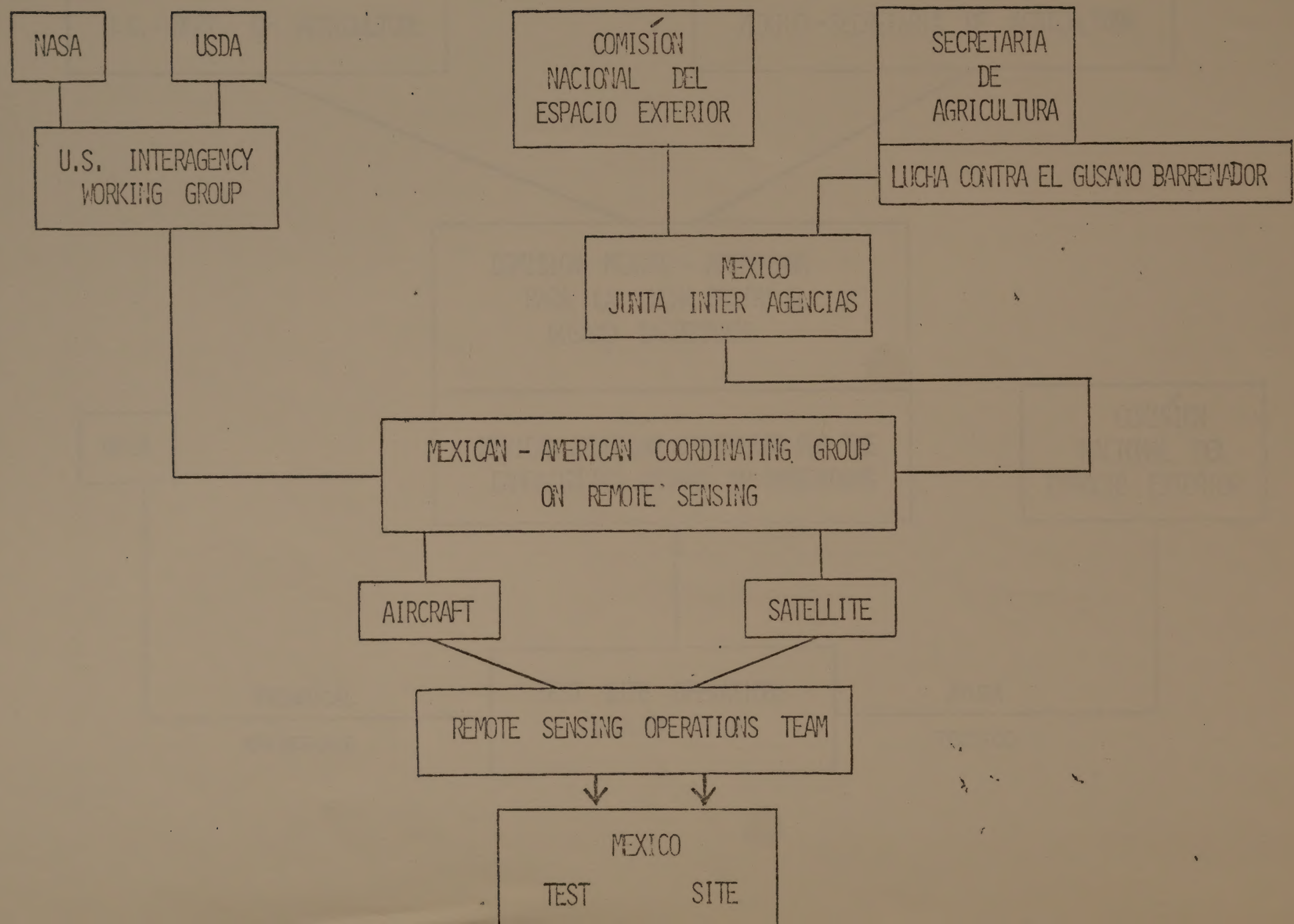
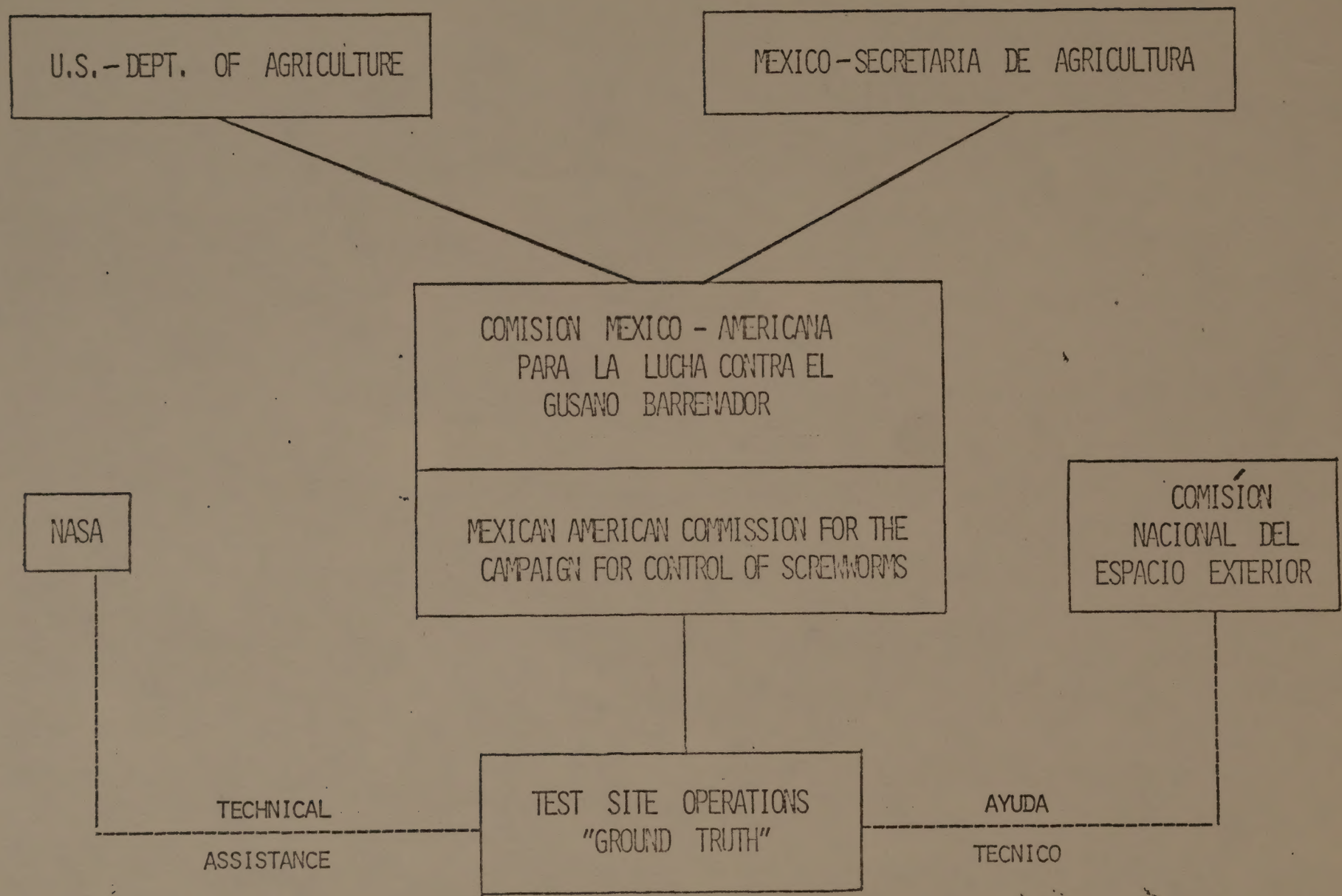

NASA
USDA
U.S. INTERAGENCY WORKING GROUP
COMISIÓN NACIONAL DEL ESPACIO EXTERIOR
SECRETARIA DE AGRICULTURA
LUCHA CONTRA EL GUSANO BARRENADOR
MEXICO JUNTA INTER AGENCIAS
MEXICAN - AMERICAN COORDINATING GROUP ON REMOTE SENSING
AIRCRAFT
SATELLITE
REMOTE SENSING OPERATIONS TEAM
MEXICO TEST SITE

FIGURE 7.


U.S.-DEPT. OF AGRICULTURE
MEXICO-SECRETARIA DE AGRICULTURA
COMISION MEXICO - AMERICANA PARA LA LUCHA CONTRA EL GUSANO BARRENADOR
MEXICAN AMERICAN COMMISSION FOR THE CAMPAIGN FOR CONTROL OF SCREWWORMS
NASA
COMISIÓN NACIONAL DEL ESPACIO EXTERIOR
TECHNICAL ASSISTANCE
TEST SITE OPERATIONS "GROUND TRUTH"
AYUDA TECNICO